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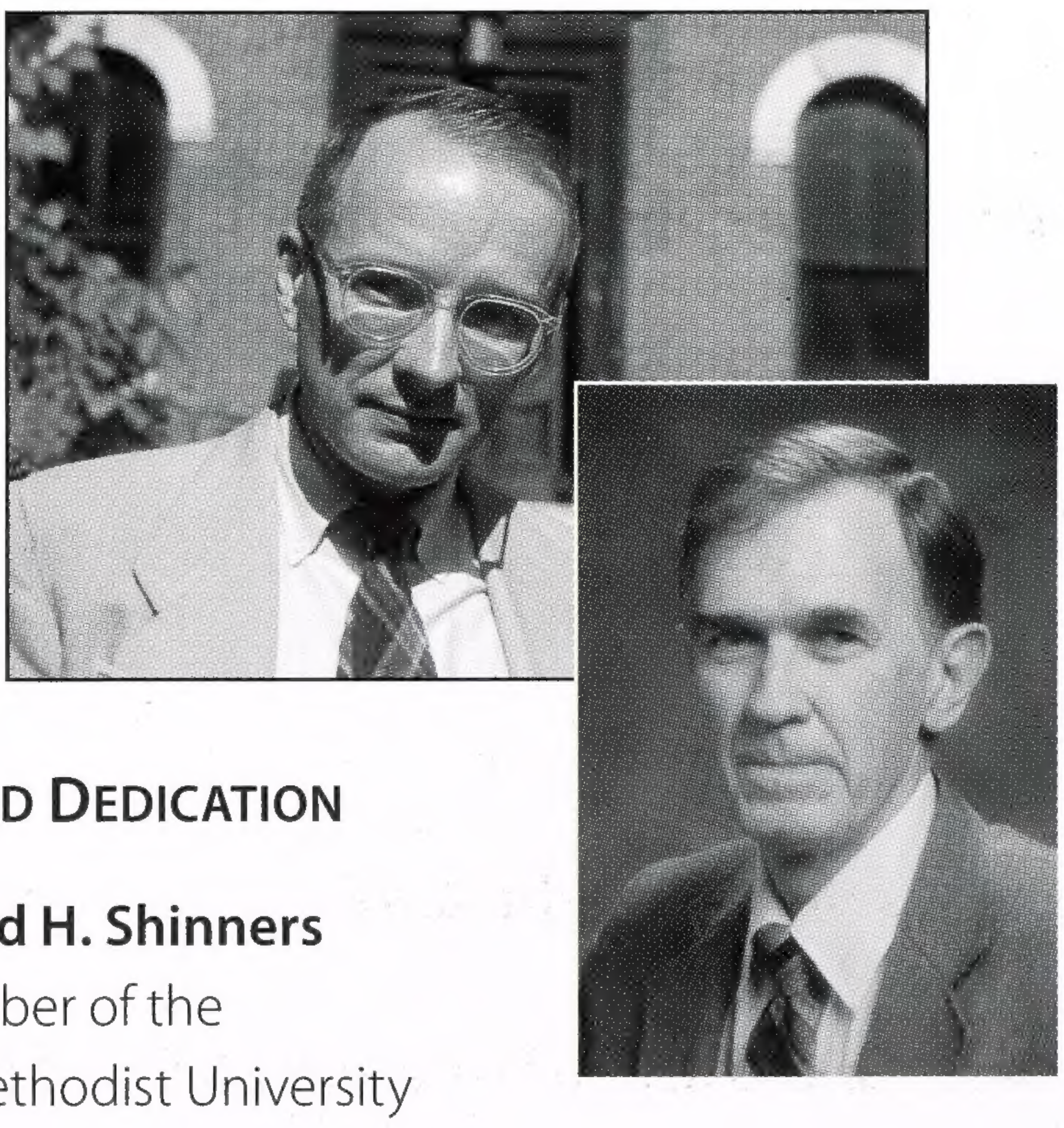

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1962—Lloyd H. Shinners (left), a member of the Southern Methodist University (SMU) faculty and a prolific researcher and writer, published the first issues of *Sida, Contributions to Botany* (now *J. Bot. Res. Inst. Texas*)

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Electronically tinted botanical illustration of *Liatris aestivalis* originally used on BRIT's anniversary poster 2001. Summer gayfeather flowers mid Jul–Aug(–Sep) and is endemic to Oklahoma and Texas. Sida 19:768. 2001. Botanical illustration by Linny Heagy ©2001.

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TABLE OF CONTENTS

SYSTEMATICS

A new hedge-nettle (**Stachys:** Lamiaceae) from the Interior Highlands of the United States, and keys to the southeastern species
JOHN B. NELSON 761

Gutierrezia elegans sp. nov. (Asteraceae: Astereae), a shale barren endemic of southwestern Colorado
AL SCHNEIDER, PEGGY LYON, AND GUY NESOM 771

Juncus digitatus (Juncaceae), a new annual rush from Shasta County, California, U.S.A.
CAROL W. WITHAM AND PETER F. ZIKA 775

Two new subspecies of **Sidalcea hickmanii** (Malvaceae) in California
STEVEN R. HILL 783

Ipomoea tehuantepecensis (Convolvulaceae): a new species from the Isthmus of Tehuantepec, Mexico
LETICIA TORRES-COLÍN, RAFAEL TORRES-COLÍN, MIRIAM P. RAMÍREZ DE ANDA, AND J. ANDREW MCDONALD 793

Illicium guajaibonense, elevated to species rank and compared with the subspecies of **Illicium cubense** (Illiciaceae)
WALTER S. JUDD, J. RICHARD ABBOTT, AND ASHLEY MORRIS 799

Neocalyptrocalyx morii (Capparaceae), a new species from central French Guiana
XAVIER CORNEJO AND HUGH H. ILTIS 807

A new species of **Lasiolaena** (Asteraceae: Eupatorieae: Gyptidinae) from Bahia, Brazil
NÁDIA ROQUE, SILVANA C. FERREIRA, AND HAROLD ROBINSON 811

Folia taxonomica 9. New species of **Passiflora** subg. **Decaloba** (Passifloraceae) from northern South America
CHRISTIAN FEUILLET AND JOHN M. MACDOUGAL 817

Folia taxonomica 10. New species of **Nautilocalyx** (Gesneriaceae: Episcieae) from the Venezuelan Guayana
CHRISTIAN FEUILLET 825

Folia taxonomica 11. Conspectus of **Varronia** (Cordiaceae: Boraginales) in the Guiana Shield with three new combinations
CHRISTIAN FEUILLET 837

A new species of the fern genus **Doryopteris** (Pteridaceae) from southeastern Brazil
ALEXANDRE SALINO 843

New records of **Poa** (Poaceae) and **Poa pfisteri:** a new species endemic to Chile
ROBERT J. SORENG AND PAUL M. PETERSON 847

Leptochloa (Poaceae: Chloridoideae) in Colombia
NEIL SNOW, PAUL M. PETERSON, AND DIEGO GIRALDO-CAÑAS 861

Eragrostis (Poaceae: Chloridoideae: Eragrostideae) in Colombia
PAUL M. PETERSON AND DIEGO GIRALDO-CAÑAS 875

Bouteloua (Poaceae: Chloridoideae: Cynodonteae: Boutelouinae) del noreste de México
YOLANDA HERRERA ARRIETA, PAUL M. PETERSON Y JESUS VALDÉS-REYNA 917

Revision of **Tocoyena** (Rubiaceae: Gardenieae) from the states of Goiás and Tocantins and a new species endemic to white-sand areas in the Brazilian Cerrado
PIERO G. DELPRETE 983

Cinco nuevas especies de **Pilea** (Urticaceae) de Costa Rica
Alexander Rodríguez y Alexandre K. Monro 995

The **Diospyros salicifolia** complex (Ebenaceae) in Mesoamerica
Mitchell C. Provance, Ignacio García Ruiz, and Andrew C. Sanders 1009

A taxonomic revision of **Crataegus** series **Lacrimatae** (Rosaceae)
J.B. Phipps and K.A. Dvorsky 1101

Dicerandra modesta (Lamiaceae): raise in rank for a disjunct perennial in a new coastal clade in Florida
Robin B. Huck 1163

Two new names in the Caribbean flora
Alain H. Liogier 1165

Trochanthera lepidota gen. and sp. nov., a fossil angiosperm inflorescence in Dominican amber
George O. Poinar, Jr., Kenton L. Chambers, and Alex E. Brown 1167

Cretacifilix fungiformis gen. and sp. nov., an eupolypod fern (Polypodiales) in Early Cretaceous Burmese amber
George O. Poinar, Jr. and Ron Buckley 1175

An Early Cretaceous angiosperm fossil of possible significance in rosid floral diversification
George O. Poinar, Jr., Kenton L. Chambers, and Ron Buckley 1183

A phylogeny of **Bejaria** (Ericaceae: Ericoideae) based on molecular data
Catherine M. Bush and Kathleen A. Kron 1193

Understanding **Oligactis** (Asteraceae: Liabeae): the true identity of **O. sessiliflora** and **O. volubilis**
Diego G. Gutiérrez 1207

Senecio cymbalarioides, S. subnudus, and **S. subpeltatus,** history of a muddle (Asteraceae: Senecioneae)
J.F. Veldkamp 1215

2C DNA content values in **Amaranthus** (Amaranthaceae)
Donald B. Pratt, Shalini N. Jhangiani, and Robert J. Wiggers 1219

Minuartia macrantha (Alsinoideae: Caryophyllaceae): morphological circumscription, geographical range, and phylogenetic affinities
Ronald L. Hartman and Richard K. Rabeler 1225

Correct basionym and combination for **Pappostipa barrancaensis** (Poaceae)
Konstantyn Romaschenko 1233

Los encinos (**Quercus:** Fagaceae) de Coahuila, Mexico
José A. Villarreal Q., Juan A. Encina D. y Miguel A. Carranza P. 1235

Thomas Walter Typification Project, VI: neotypes for an additional 18 Walter names
Daniel B. Ward 1279

BOTANICAL HISTORY

Caryophyllaceae in North America: change over the last 110 years
Richard K. Rabeler and Ronald L. Hartman 1285

The Big Thicket: pristine wilderness or archeologically understudied?
Michael H. MacRoberts and Barbara R. MacRoberts 1291

ETHNOBOTANY

Diferencias en el uso de plantas entre hombres y mujeres en una comunidad de pie de monte del norte del Ecuador
David Suárez Duque 1295

METHODS AND TECHNIQUES

Tree canopy research and student experiences using the doubled rope climbing method
Courtney M. Kilgore, Harold W. Keller, Sydney E. Everhart, Angela R. Scarborough, Kenneth L. Snell, Melissa S. Skrabal, Charly Pottorff, and Joseph S. Ely 1309

FLORISTICS, ECOLOGY, AND CONSERVATION

Aristolochia schultzeana (Aristolochiaceae) new to Ecuador
Douglas H. Goldman 1337

Asclepiadoideae (Apocynaceae) como maleza en el cultivo del agave tequilero (**Agave tequilana** var. **"azul"**)
Irma López-Muraira, Rubén Iruegas, Isaac Andrade González y Juan Florencio Gómez Leyva 1341

The species of **Fumaria** (Papaveraceae) in Texas, including **F. densiflora,** first records from North America
Monique Reed, Richard V. Lansdown, and Tim C.G. Rich 1347

Noteworthy collections from the southeastern United States
Bruce A. Sorrie and Richard J. LeBlond 1353

Analysis of the completeness of vascular plant records in Florida
Justin K. Williams and Anica Debelica 1363

Species richness of vegetational areas of Texas: a first approximation
Michael H. MacRoberts and Barbara R. MacRoberts 1373

Carex breviculmis (Cyperaceae), new to the flora of North America
Lucas C. Majure and Charles T. Bryson 1381

Vascular flora of C. Bickham-Dickson/Red River Education and Research Park, Caddo Parish, Louisiana: an oxbow lake community, with comments on exotic/native species ratios
Michael H. MacRoberts, Barbara R. MacRoberts, and Gary M. Hanson 1389

A floristic survey of vascular plants over parts of northeastern New Mexico
Michael H. Schiebout, Donald L. Hazlett, and Neil Snow 1407

Checklist of the vascular plants of Fayette County, Pennsylvania
Cynthia M. Morton and Loree Speedy 1449

Rare and endemic plants of the Big Thicket: a phytogeographical analysis
Michael H. MacRoberts and Barbara R. MacRoberts 1475

Annotated checklist of the vascular flora of the Loblolly Unit of the Big Thicket National Preserve, Liberty County, Texas
Larry E. Brown, Barbara R. MacRoberts, Michael H. MacRoberts, Warren W. Pruess, I. Sandra Elsik, and Suzanne Birmingham Walker 1481

Neptunia plena (Fabaceae: Mimosoideae) rediscovered in Texas
Alfred Richardson and Ken King 1491

Asclepias hirtella (Apocynaceae) newly documented for the flora of Texas
Matt White 1495

Lilaeopsis carolinensis (Apiaceae) a species new to Texas and a key to **Lilaeopsis** in Texas
Stephan L. Hatch and A. Tucker Slack 1497

Book Reviews and Notices 770, 782, 792, 798, 816, 860, 982, 994, 1008, 1166, 1174, 1206, 1214, 1224, 1232, 1234, 1284, 1290, 1294, 1340, 1346, 1352, 1362, 1372, 1380, 1388, 1448, 1480, 1490

Announcements 1494

Reviewers for Volume 1 (2007) and Volume 2 (2008)—1499

Index to Volume 1 (2007) and Volume 2 (2008)

Titles of Articles with Authors—**1501**
Authors—**1507**
Botanical Names and Subjects—**1509**
New Names and Combinations—**1523**

INDEX to new names and new combinations in *J. Bot. Res. Inst. Texas* 2(2), 2008

Bouteloua tamaulipensis G.J. Pierce ex D. Pacheco & Columbus, sp. nov.—**966**
Crataegus lancei J.B Phipps, sp. nov.—**1143**
Cretacifilix G.O. Poinar & R. Buckley, gen. nov.—**1176**
Cretacifilix fungiformis G.O. Poinar & R. Buckley, sp. nov.—**1176**
Dicerandra modesta (Huck) Huck, comb. et stat. nov.—**1163**
Diospyros acapulcensis subsp. **chiquimulensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**1025**
Diospyros acapulcensis subsp. **dwyeri** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**1027**
Diospyros acapulcensis subsp. **guanacastensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**1029**
Diospyros acapulcensis subsp. **mejocotensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**1031**
Diospyros acapulcensis subsp. **nicaraguensis** (Standl.). M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov.—**1033**
Diospyros acapulcensis subsp. **pedromorenoi** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**1036**
Diospyros acapulcensis subsp. **rivensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**1039**
Diospyros acapulcensis subsp. **veraecrucis** (Standl.) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov.—**1044**
Diospyros aequoris subsp. **balsensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**1061**
Diospyros aequoris subsp. **chutlensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**1065**
Diospyros aequoris subsp. **martineziana** (Standl. ex Leavenworth) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov.—**1069**
Diospyros aequoris subsp. **rekoi** (Standl.) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov.—**1071**
Diospyros aequoris subsp. **tehuantepecensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**1074**
Diospyros yucatanensis subsp. **spectabilis** (Lundell) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov.—**1086**
Doryopteris jequitinhonhensis Salino, sp. nov.—**843**
Gutierrezia elegans Al Schneider & P. Lyon, sp. nov.—**771**
Hedyotis ekmanii Alain, nom. nov.—**1165**
Illicium guajaibonense (Imkhanitskaya) Judd & Abbott, comb. et stat. nov.—**800**
Ipomoea tehuantepecensis L. Torres-Colín, R. Torres-Colín, M.P. Ramírez & J.A. McDonald, sp. nov.—**793**
Juncus digitatus C. Witham & Zika, sp. nov.—**775**
Lachnociona G.O. Poinar, K.L. Chambers & R. Buckley, gen. nov.—**1184**
Lachnociona terriae G.O. Poinar, K.L. Chambers & R. Buckley, sp. nov.—**1184**
Lasiolaena lychnophorioides Roque & H. Rob., sp. nov.—**812**
Nautilocalyx crenatus Feuillet, sp. nov.—**825**
Nautilocalyx orinocensis Feuillet, sp. nov.—**833**
Nautilocalyx paujiensis Feuillet, sp. nov.—**827**
Nautilocalyx pusillus Feuillet, sp. nov.—**827**
Nautilocalyx roseus Feuillet, sp. nov.—**830**
Nautilocalyx ruber Feuillet, sp. nov.—**830**
Nautilocalyx vestitus Feuillet, sp. nov.—**833**
Neocalyptrocalyx morii X. Cornejo & H.H. Iltis, sp. nov.—**807**
Pappostipa barrancaensis (F.A. Roig) Romaschenko, comb. nov.—**1233**
Passiflora angusta Feuillet & J.M. MacDougal, sp. nov.—**818**
Passiflora rufa Feuillet & J.M. MacDougal, sp. nov.—**822**
Pilea alfaroana Al. Rodr. & A.K. Monro, sp. nov.—**995**
Pilea gamboana Al. Rodr. & A.K. Monro, sp. nov.—**997**
Pilea herrerae Al. Rodr. & A.K. Monro, sp. nov.—**1000**
Pilea longibracteolata Al. Rodr., A.K. Monro & L. Acosta, sp. nov.—**1002**
Pilea moragana Al. Rodr. & A.K. Monro, sp. nov.—**1004**
Poa pfisteri Soreng, sp. nov.—**850**
Rosaceae subseries **Robustae** J.B. Phipps, subser. nov.—**1124**
Rosaceae subseries **Tenues** J.B. Phipps, subser. nov.—**1108**
Salvia toaensis Alain, nom. nov.—**1165**
Sidalcea hickmanii subsp. **napensis** S.R. Hill, subsp. nov.—**783**

Sidalcea hickmanii subsp. **pillsburiensis** S.R. Hill, subsp. nov.—**786**
Stachys iltisii J. Nelson, sp. nov.—**761**
Tocoyena arenicola Delprete, sp. nov.—**988**
Trochanthera G.O. Poinar, K.L. Chambers & A.E. Brown, gen. nov.—**1168**
Trochanthera lepidota G.O. Poinar, K.L. Chambers & A.E. Brown, sp. nov.—**1168**
Varronia bullata subsp. **humilis** (Jacq.) Feuillet, comb. nov.—**837**
Varronia cremersii (Feuillet) Feuillet, comb. nov.—**838**
Varronia marioniae (Feuillet) Feuillet, comb. nov.—**839**

A NEW HEDGE-NETTLE (*STACHYS:* LAMIACEAE) FROM THE INTERIOR HIGHLANDS OF THE UNITED STATES, AND KEYS TO THE SOUTHEASTERN SPECIES

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ABSTRACT

A new and geographically restricted species in the "hedge-nettle" genus, *Stachys* (Lamiaceae), is described from the Interior Highlands of the United States, as **Stachys iltisii,** from Arkansas and Oklahoma. Two keys are provided for distinguishing the Southeastern hedge-nettles.

ZUSAMMENFASSUNG

Eine neue Art in der Ziest-Gattung (*Stachys*, Lamiaceae), mit kleinräumiger Verbreitung im Inneren Hochland von Arkansas und Oklahoma, wird beschrieben: **Stachys iltisii.** Zwei Schlüssel dienen zur Bestimmung der Ziest-Arten aus der südöstlichen USA.

Stachys is one of the larger genera within the Lamiaceae, comprising nearly 300 species, and nearly cosmopolitan, absent from Australasia. Its centers of species diversity include warm-temperate portions of western Asia and the Mediterranean, southern Africa, and portions of North and South America (İlçim et al. 2008). The genus in North America, north of Mexico, contains about 45 species, particularly concentrated west of the Rocky Mountains (especially the Pacific states) and in the east, along the Atlantic seaboard states and in the Appalachian region. Southeastern species occur in a wide variety of habitats, most often in mesic sites, and at a broad range of elevations. The North and South American species were studied in detail by Epling (1934); Mulligan and Munro (1989) provide a comprehensive assessment of the North American taxa north of Mexico. Ongoing studies in the genus show that an additional species should be recognized.

Stachys iltisii J. Nelson, sp. nov. (**Figs. 1–3**). Type: UNITED STATES. Arkansas. Logan Co.: crowded population on rocky ground in thin woods remnant, S side of Lodge Drive, 1.5 mi (2.4 km) W of AR Highway 309, near top of Magazine Mountain, 18 Jun 2007, *J.B. Nelson 26650* (holotype: USCH; isotypes: APCR, BRIT, F, FSU, NCU, NY, OKL, OKLA, STAR, UARK, US, WIS).

Species propria, haec planta est abundanter glandulifer-pubens in lateribus caulium et in angulis, atque folia pubentissima sunt. Caules et folia, contusi, redolent muschate. Est similis *S. eplingii*, sed differt quod habet maiora aliquanto tenuiora folia quae inferiore pagina tam glandulifera non sunt, et quod habet flores paulo minores, haec plerumque compactiora in verticillis aggregatis. Crescit in Oklahoma et Arkansase.

Potentially robust perennial **herbs** to 1 m tall or taller from vigorous, pale, fragrant rhizomes, often in dense colonies; **stems** erect, occasionally branched, older plants commonly branched; stem sides and angles densely pubescent with a mixture of glandular and eglandular hairs, the glandular hairs capitate, the eglandular hairs with 3 or more cells, to 3 mm long, spreading and reflexed; **leaves** spreading, somewhat lax, densely pubescent on both surfaces with glandular and eglandular hairs, the latter mostly appressed on upper surface, and erect on lower surface, the lower surface equipped as well with scattered sessile (or nearly sessile) capitate glands; the crushed leaves with a musky walnut-spice-fish scent; mid-stem leaves 4–6 cm broad, 10–17(–19) cm long, commonly lyrate basally, featuring a somewhat narrowed waist, with distally convex margins; **inflorescences** commonly elongated at maturity (fruiting), the lowest and oldest several verticils usually slightly separated, the more distal and younger verticils more or less crowded together, thus nearly compact; **cymules** each with 6–8-flowers, the verticils thus 12–16-flowered, mostly (turbinate)-hemispheric to nearly spherical; open flowers are visited by a variety of insects, including hon-

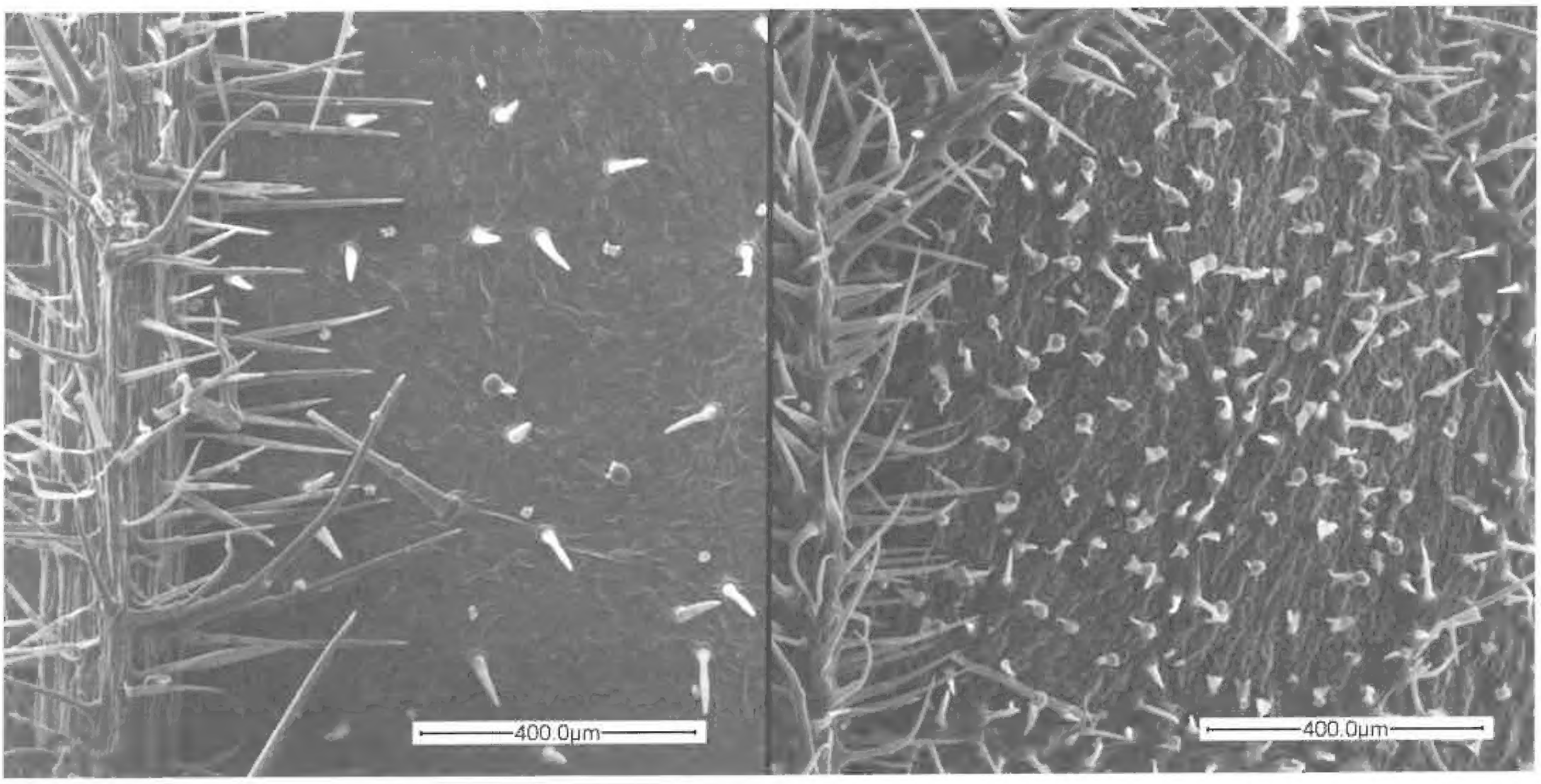

Fig. 1. Lower (abaxial) leaf surface SEM images of *Stachys iltisii* and *Stachys eplingii*: comparative surface features along midvein of midstem leaves; same scale for both images. LEFT: *Stachys iltisii* (*J. Nelson 26653*, LeFlore County OK, USCH) showing few glandular hairs. RIGHT: *Stachys eplingii* (*H. Allard 19940*, Fauquier County VA [paratype from type locality], WVA) showing abundant glandular hairs.

eybees, small bumblebees, and wasps; **calyces** campanulate, densely pubescent with glandular and eglandular hairs, tube (3.2–)3.8–4 mm long, the lobes less that one-half the length of the tube, 1.5–2 mm long, deltoid, minutely apiculate; **corollas** pink, 11–11.5 mm long from base to tip of galea, galeae frequently notched or indented apically; the lower lip generally declined 90° at full anthesis, more so with age, 6 mm long, featured prominent pink-purple blotches and spots on adaxial surface; corolla tube prominently saccate toward base on lower side, internally glabrous, but with prominently slanting (oblique) annulus, this copiously pubescent with soft, bulbous trichomes; **mericarps** 1.5 mm wide, 1.5–1.6 mm long, dark brown, irregularly and minutely verrucose.

Additional specimens seen: **UNITED STATES. ARKANSAS: Crawford Co.:** *S. Burgess 102*, McMinn Gap, Forest Service Rd 1003 (UAM, UARK). **Franklin Co.:** *L. Kirschberger 109*, 14 Jun 1996, Ozark National Forest (UAM). **Garland Co.:** *D. Demaree 56064*, 30 May 1967, rocky hillsides on Hickory Nut Mountain (BRIT); and same location and date, *Demaree 56078* (ISC). **Izard Co.:** *F. Pennell 10686*, 1 Jun 1920 (NY). **Logan Co.:** *D. Demaree 17743*, 18 Jun 1938, Magazine Mountain (BRIT, FSU, WVA); *H. Iltis 5048*, 17 Jun 1954, Magazine Mountain (UARK); *H. Iltis 5374*, 9 Jun 1955, ravine on N slope of Magazine Mountain (BRIT, GH, WIS); *E. Palmer 23214*, 11 Jun 1923, slopes of Magazine Mountain (MO, UARK); *H. Pyle 796*, 15 Jun 1937, Magazine Mountain (UARK); *G. Tucker 15499*, 23 Jul 1979, Magazine Mountain, 1.5 mi W of Green Field (APCR); *G. Tucker 22898*, 10 Jul 1983, Magazine Mountain (UAM). **Montgomery Co.:** *D. Demaree 45661*, 10 Jun 1962, Hickory Nut Mountain (GH); *J. Miller 187*, 24 Jun 1970, road on High Peak (BRIT, UARK); *J. Roberts 273*, 26 May 1977, Winding Stairs, E side of Little Missouri River (UARK); *E. Sundell 2351*, 28 May 1981, Little Missouri Falls (FLAS, NLU, UAM, UARK); *R. Thomas 100517*, 27 Jun 1987, Collier Springs (NLU); **Newton Co.:** *A. McWilliam 25*, 19 Jun 1969, roadside between Kingston and Boxley (UARK). **Perry Co.:** *S. Walker s.n.*, 8 Jun 1995, N side of Cedar Creek (UARK). **Polk Co.:** *D. Demaree 23183*, 13 Jun 1942, Rich Mountain (BRIT, GH, MIN); *D. Demaree 54519*, 19 Sep 1966, Rich Mountain (BRIT); *H. Iltis 5175*, 20 Jun 1954, Jackfork sandstone, 8 mi W of Mena (UARK); *A. McWilliam 482*, 1 Jul 1955, 9 mi W of Mena (UARK); *J. Nelson 26652*, Rich Mountain, 0.65 mi E of Queen Wilhelmina State Park at AR Hwy#272 (NBYC, UARK, USCH); *J. Nelson 26654*, 19 Jun 2007, Rich Mountain at Pioneer Cemetery, 3 mi E of OK state line (CLEMS, STAR, USCH); *J. Nelson 26655*, 19 Jun 2007, Rich Mountain fire tower, 2 mi E of AR Hwy#272 (APCR, FMUH, USCH); *J. Nelson 26657*, 20 Jun 2007, shady woods along Mine Creek, 2.5 mi E of Shady (town) (USCH); *J. Nelson 26658*, 20 Jun 2007, shady woods next to stream, 4.1 mi E of Shady (town) on AR Hwy #25 (USCH). **OKLAHOMA: LeFlore Co.:** *M. Hopkins 574*, 21 May 1944, meadow at base of Rich Mountain (OKL); *J. Nelson* 26653, 19 Jun 2007, 1.25 mi W of AR state line on OK Hwy #1 (OKL, OKLA, USCH); *E. Palmer 20615*, 23 Sep 1921, wooded slopes of Rich Mountain (F, NY); *E. Palmer 21642*, 1 Jun 1922, N slopes of Rich Mountain (NY); *U. Waterfall 17005*, 31 May 1962, 10 mi SE of Stapp near Arkansas border (OKLA); *F. Means, Jr. 3571*, 15 Jun 1968, N slope of Rich Mountain, 0.25 mi W of Arkansas border (OKLA); *J. and C. Taylor 32462*, 12 Aug 1984, State Hwy #1, 6.8 mi E of its junction with US 259 (BRIT). **McCurtain Co.:** *G. Goodman 8360*, 11 Jun 1973, S end of Beaver Bend State Park (OKL); *M. Hopkins 380*, 20 May 1944, Beaver Bend State Park (OKL).

Stachys iltisii is endemic to the Interior Highlands of Arkansas and Oklahoma. The oldest known collection is that made by E. J. Palmer in 1920, from Izard County, Arkansas, which represents the eastern-most location for this plant. Its first recognition in the literature was made by Epling (1934), who considered it, additionally known by then from collections in Oklahoma, as a thin-leaved and unnamed variant of *Stachys nuttallii* Shuttlew. ex Bentham. Fernald (1950), despite considerable disagreement with Epling's assessments on *Stachys* in general (1943), concurred that the plants of the Interior Highlands belong in *S. nuttallii*, as did Gleason (1952). Hugh Iltis (WIS) by way of annotation on the original label of his *#5374* (BRIT) from Magazine Mountain, Logan County, AR on 9 Jun 1955, suggested that these plants rightly constitute a recognizable entity within *S. nuttallii*, offering "ssp. nov. *arkansanus*" for it. Nelson and Fairey (1979) essentially concurred with Epling in recognizing these plants as distinctive within the *S. nuttallii* complex, but maintained them as being a part of a distinctive and new taxon, *S. eplingii*; they treated the plants of the Interior Highlands as forming the western (and disjunct) end of the range of *S. eplingii* (the eastern distribution consisting of primarily Appalachian portions of West Virginia, Virginia, Maryland, District of Columbia, and historically, North Carolina). The somewhat conservative approach to the taxonomic status of these plants taken by Nelson and Fairey at the time is evident within the protologue of their description of *S. eplingii*: they list (1979, p. 493) three specimens from Arkansas as paratypes for *S. eplingii* (*Demaree 17743* from Logan County; *Miller 187* ... "Smith" was used for this collection, but in error... from Montgomery County; *Iltis 5175* from Polk County). Their listing these paratypes for a different taxon has no bearing on the matter at hand, and these three collections presently serve as paratypes for *S. iltisii* (see above).

This taxonomic position was maintained by Nelson (1981), and by Mulligan and Munro (1989; whose formulation is the most recent treatment for all the North American species of *Stachys*), by Gleason and Cronquist (1991), and finally by Smith (1994).

Recent field investigation in Arkansas and Oklahoma (during one of the hotter and stormier, lightning-filled summers on record, 2007) and study of considerably more herbarium material since 1979 reveals that the opinion expressed by Epling and Iltis was legitimate, at least in the sense that the plants of the Interior Highlands are distinctive within the *S. nuttallii* "complex." There is no question that these plants share many features with *S. eplingii*, and the two entities are surely related. Substantial differences between these two species are apparent, and based on more recent collections, it is obvious that the two taxa can be consistently separated, both from fresh material, and from herbarium specimens. Both species bear short-stalked, capitate glands on the abaxial leaf surface, with unicellular, spheroidal heads, 25–30 µm in diameter. The lower leaf surface of *S. iltisii* is sparingly glandular, while that of *S. eplingii* is densely and prominently atomiferous-glandular (Fig. 1), to the point of having a somewhat shiny, golden surface (with magnification) below the non-glandular pubescence, as well as often leaving something of a yellowish, slightly oily stain on newspapers when pressed. The leaf blades of *S. iltisii* are longer, broader, and somewhat thinner in texture than those of *S. eplingii*. Additionally, the leaf blades of *S. iltisii* are frequently somewhat narrowed in the lower third, thus somewhat lyrate, and widest toward the middle. *Stachys eplingii* has more ovate leaves, usually widest in the lower third. In *S. iltisii*, the apex of the early blooming stem is relatively delicate and somewhat flexuous, while that in *S. eplingii* is stiffer. The fruiting inflorescence of *S. iltisii* is commonly compact, 1.5–2cm between the lowest verticils, whereas that of *S. eplingii* commonly exhibits more space, (2–)3–4cm between the lowest verticils.

Stachys eplingii is found in boggy places within the Appalachians. Its most common habitat from West Virginia into northern Virginia includes wet, saturated meadows. *Stachys iltisii* is generally found in upland forested habitats, commonly on thin soil of rocky places, in both the Ozark Plateau and the Ouachita Mountains, thus on both sides of the Arkansas River Valley, though probably more widely distributed in the Ouachitas. Although substantial differences in geology and soil types exist between the Ozark Plateau and the Ouachitas, sites occupied by *S. iltisii* do not appear to be unusual or particularly special, and in fact,

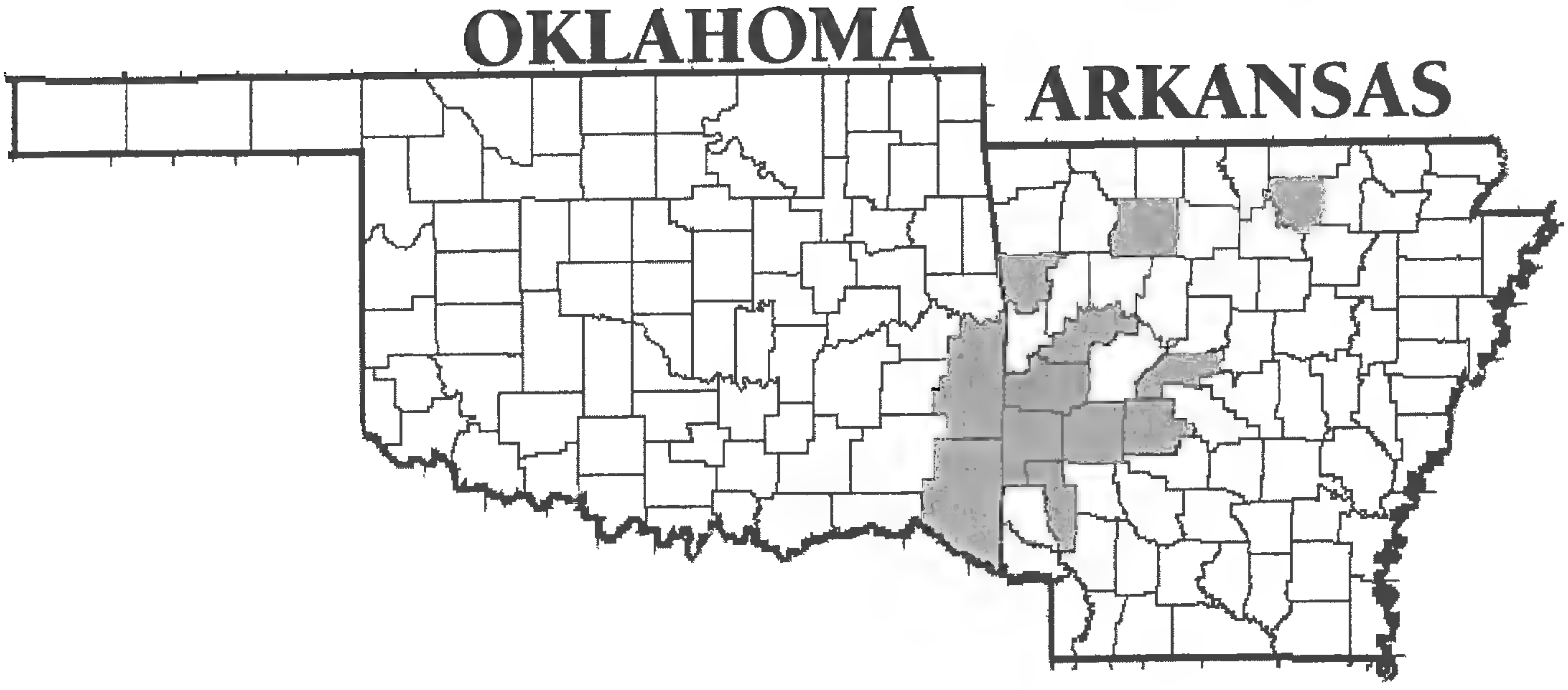

Fig. 2. County distribution of *Stachys iltisii* in Oklahoma and Arkansas.

open roadsides tend to make excellent habitat for it, where it frequently grows with weedy plants such as *Coronilla varia, Daucus pusilla,* and *Ambrosia trifida.* Common woody associates, in less disturbed sites include *Quercus alba, Acer rubrum, Robinia pseudo-acacia, Juglans nigra, Ostrya virginiana,* and *Sassafras albidum.* Nearly every population located during this field effort grew with *Toxicodendron radicans, Parthenocissus quinquefolia,* and *Rubus occidentalis.*

An overview of biological endemism in the Interior Highlands is not the purpose of this paper. This subject has been amply addressed for a considerable number of plants and animal species, and is discussed in the recent literature; Robison and Allen (1995) provide a useful summary. Zollner et al. (2005) provide an enumeration of the vascular plant taxa endemic to the Interior Highlands (24 species plus 12 subspecies or varieties of more widely distributed species). Vicarious distributions of plant taxa between the Interior Highlands and the Appalachians have been long recognized: Steyermark (1934) lists 87 vascular taxa of the Ozark Plateau that also occur in the southern Appalachians. "Classic" examples include the distributions of *Magnolia tripetala, Cladrastis lutea, Robinia pseudo-acacia,* and perhaps *Halesia carolina* (Little 1970). The common notion regarding disjunction of the same species, or of two related species, presumes some probable interconnection in the past (Hardin & Cooper 1967), followed by potential evolutionary divergence. Vicariance and subsequent speciation has been demonstrated for fish species forming species "pairs" in the Ozarks and the Appalachians (Strange & Burr 1997), and various examples exist for vascular plants, such as *Castanea ozarkensis* and *C. pumila.* In the case of *Stachys iltisii* and *S. eplingii,* such potential commonality of distribution no longer exists, and the two entities are now fully separated. Approximately 1000 km (640 mi) currently separate their nearest points of distribution. Based upon the isolation of the plants within the Interior Highlands from all other related hedge-nettles, and upon the ease of separating plants based on simple morphology, *Stachys iltisii* is here recognized and described at the level of species.

Personnel within the Arkansas Natural Heritage Commission (2005) list *Stachys iltisii* as *S. eplingii* (thus following Nelson & Fairey 1979), and have assigned its state rank as "INV" (Inventory Element, "of conservation concern"). The Oklahoma Natural Heritage Inventory (2003) similarly maintains *S. iltisii* as *S. eplingii,* tracking it as a rare species. At least 40 known populations are verified for 13 counties in Arkansas and Oklahoma. Reports of additional county occurrences in Arkansas (Howard and Scott Counties) but not on specimens seen from them, is consistent with the known range (Fig. 2).

Reference to this species as an element of the flora of the Southeastern United States comes from its presence in Arkansas, a politically delimited area generally recognized by botanists as a portion of the

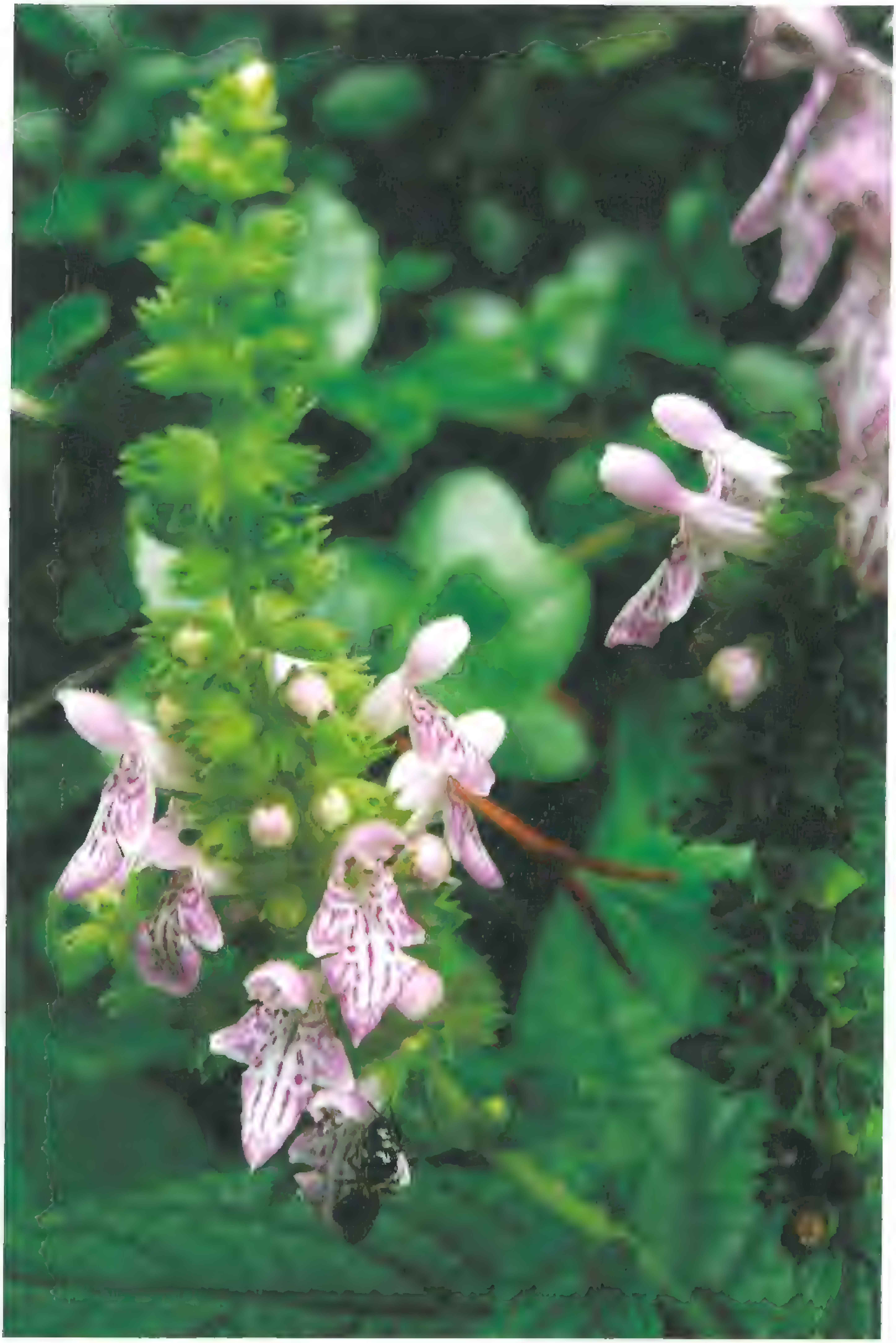

Fig. 3. *Stachys iltisii*: living plants (population of *Nelson 26653*, LeFlore County OK) with unidentified pollinator (?) at lower left.

"Southeast." Although Oklahoma is not a Southeastern state, its eastern portions do indeed harbor many "Southeastern" species.

"Ozark hedge-nettle" may be an appropriate common name. This is a handsome species, often robust and conspicuous (Fig. 3), and fairly easy to spot from a moving vehicle. Due to their tendency toward a somewhat compact inflorescence, especially in the sun, the plants do resemble *Teucrium canadense*...but then, various *Stachys* species are commonly confused with "Canada germander," frequently causing field-trip turn-arounds.

Etymology.—Iltis' unofficial differentiation of this plant as a new taxon deserves recognition. Its occurrence in Oklahoma as well as Arkansas, however, makes the choice of the epithet "*arkansana*" (*Stachys* as a noun requires a feminine ending) unwarranted. As a way of commemorating Hugh Iltis' interest in the vegetation of the Interior Highlands, and in the genus *Stachys*, and as well acknowledging his tremendous contributions to botany, this taxon is thus named in his honor.

Except that *Stachys iltisii* and *S. eplingii* are (were?) never really common, and that there is a relatively low number of historic collections of each, it is somewhat remarkable that Epling (1934) did not consider formally recognizing them in 1934. On the other hand, *Stachys* in the Southeastern United States has commonly been considered a troublesome genus. Its current taxonomy is fairly stable, although several of the characters (e.g., stem pubescence, petiole length, and calyx lobe dimensions) useful in separating taxa are variously continuous. The considerable variation in some species groups suggests future usefulness to be attained from cytological and breeding system studies.

Nevertheless, practical taxonomy demands results. To this end, two keys are provided for distinguishing *Stachys iltisii* from the other Southeastern species. The first uses relative petiole length as a primary distinction, the second using shape of the calyx lobes. The different structuring of these keys is provided to emphasize different characters; with a particular plant or specimen in hand, the user may find that one or the other key provides the easier route to identification.

SOUTHEASTERN *STACHYS*: KEY #1

1. Annual; corolla scarcely exserted from calyx; LA-MS-AL-FL-SC ________ **S. agraria**

1. Perennial; corolla prominently exserted from calyx, widespread.

2. Petioles obvious (at least some of those in the middle portion of the stem at least 1/5 as long as the leaf blade).

3. Calyx tubes glandular.

4. Leaf blade margins dentate or nearly so; stem angles copiously pubescent with long (to 3 mm), spreading hairs ________ **S. clingmanii**

4. Leaf blade margins mostly crenate; stem angles glabrate or pubescent with mostly short, retrorse hairs.

5. Leaf blades <3 cm wide; plants perniciously weedy, commonly in dense patches, scarcely to .75 m tall, with white, rounded tubers terminating rhizomes ________ **S. floridana**

5. Leaf blades commonly >3 cm wide; plants not weedy, never in dense patches, commonly 1 m tall of greater; rounded tubers absent.

6. Leaf blades ovate, the bases cordate; margins crenulate; IN-OH-WV-KY-VA ________ **S. cordata**

6. Leaf blades elliptic-oblong, the bases rounded to slightly cordate; margins crenate to serrate; KY-TN-GA-AL-SC ________ **S. nuttallii**

3. Calyx not glandular, or very slightly so.

7. Calyx glabrous to sparsely pubescent; petioles well-developed, especially in shade forms ________ **S. tenuifolia**

7. Calyx variously hairy, but at least hispidulous, frequently strongly hispid; petioles short or long.

8. Petioles usually well developed; stem angles abundantly pubescent with spreading hairs; blade margins commonly dentate ________ **S. clingmanii**

8. Petioles short to nearly absent; stem angles commonly pubescent, with retrorse hairs; blade margins serrate, but not dentate________ **S. hispida**

2. Petioles short (the midstem leaves with petioles less than 15mm) or absent.

9. Leaves linear-lanceolate to narrowly lanceolate, usually widest at or near the base; leaf margins entire to crenulate, rarely serrulate, and then mostly toward the apex.

10. Leaf blades abundantly pubescent below with appressed hairs, thus closely tomentose, the lower surface felty or velvety; corolla white, pink, or purplish.

11. Stems angles and sides abundantly soft pubescent, with mostly soft, spreading hairs, corolla white; rare adventive (SC) **S. pilosa**

11. Stem angles and sides abundantly pubescent, the angles equipped with at least some stiff, retrorse hairs, corolla purple; rare adventive (AL) **S. palustris**

10. Leaf blades variously pubescent or glabrate, but never felty or velvety; corolla pink.

12. Leaf blades narrow, 3–6 mm wide; plants generally glabrous to moderately pubescent; blade margins entire to obscurely crenulate **S. hyssopifolia**

12. Leaf blades broader, 5–8 mm wide; plants frequently hispidulous or at least moderately pubecent, or abundantly hairy; blade margins crenulate to serrulate **S. aspera**

9. Leaves ovate to elliptic, widest near the center or toward the apex, oblong; leaf margins crenate to sharply serrate for nearly the entire length.

13. Stem sides commonly pubescent above.

14. Calyx lobes lanceolate; flower 6 per vertical; leaf margins serrate-crenate.

15. Leaves generally subsessile, the petioles thick, not longer than 6mm; blades densely pubescent, frequently soft-pilose to scaberulous; leaf margins serrate; introduction from farther north and west (VA) **S. arenicola**

15. Leaves generally petioled up to 15mm long, although commonly shorter, and relatively slender; blades pubescent on both surfaces, but never to the point of being pilose or scaberulous; leaf margins crenate-serrulate; KY-TN-GA-AL-SC **S. nuttallii**

14. Calyx lobes deltoid; flowers 8 or more per verticil; leaf margins crenate-crenulate; native s with bipolar distribution, OK-AR, WV-MD.

16. Lower leaf surface densely sessile- and stipitate-glandular, blades ovate, widest in lower third of leaf; adjacent upper verticils separated in fruit; WV-VA-MD-DC (NC) **S. eplingii**

16. Lower leaf surface glandular, but not densely so; blades elliptic-ovate, widest at middle; adjacent upper verticils commonly crowded in fruit; OK-AR **S. iltisii**

13. Stem sides glabrous, the angles pubescent.

17. Fruiting calyx lobes lanceolate, hispidulous to hispid, about half as long as the calyx tube **S. hispida**

17. Fruiting calyx lobes deltoid or triangular, shorter than half the length of the calyx tube.

18. Leaf margins sharply serrate, nearly always with sharp teeth; bracts gradually reduced upward from lowest flowering node, leaf blades elliptic, rounded to truncate at base; Blue Ridge (VA) **S. subcordata**

18. Leaf margins serrate to crenate; teeth often more rounded; bracts abruptly reduced upward from lowest flowering node; leaf blades oblong-elliptic; Blue Ridge to upper piedmont, VA-NC-TN-SC-GA **S. latidens**

SOUTHEASTERN *STACHYS:* KEY #2

1. Fruiting calyx lobes deltoid to broadly triangular, mostly <1/2 tube length.

2. Stem sides pubescent; foliage glandular, often with musky scent when crushed.

3. Petioles short to absent, blades mostly rounded to truncate-cordate.

4. Lower leaf surface densely glandular, with atomiferous/short-stipitate golden glands; blades prevailingly ovate, broadest toward base; WV-VA-MD (NC) **S. eplingii**

4. Lower surface glandular, but not densely; blades prevailing elliptic, somewhat lyrate toward base, broadest toward midblade; AR-OK **S. iltisii**

3. Petioles well developed, blades commonly cordate at the base.

5. Top of blooming stem frequently flexuous, somewhat lax; blades ovate-rounded, IN-OH-WV-KY-VA-NC **S. cordata**

5. Top of blooming stem stiffish, not lax; blades oblong-elliptic; KY-TN-GA-AL-SC **S. nuttallii**

2. Stem sides glabrous; crushed fresh foliage with grass-like scent, not musky.

6. Leaves sessile to subsessile; bracts rapidly reduced upward (Appalachians, GA-WV) **S. latidens**

6. Leaves subsessile or petioles to 10mm long; bracts gradually reduced upward (Blue Ridge, VA) **S. subcordata**

1. Fruiting calyx lobes lanceolate, narrowly triangular, or nearly subulate, half as long as tube (or > 1/2 as long).

7. Leaf blades linear to lanceolate.

8. Corolla white; stem sides with at least moderate pubescence on the highest sterile internode, moderately to densely pubescent on higher internodes; lower leaf surface abundantly pubescent to velvety-pilose (SC) **S. pilosa**

8. Corolla pink; stem sides without pubescence, except for internodes within the inflorescence, which may bear light villous or glandular hairs; lower leaf surface glabrous or pubescent, but not velvety.
9. Leaf blade margins entire to crenate; plants generally glabrous **S. hyssopifolia**
9. Leaf blade margins serrulate with at least a few teeth; plants glabrous or pubescent.
10. Stems strict or sparingly branched; leaves sessile or barely petioled, the blades crenate to serrate with shallow teeth **S. aspera**
10. Stems frequently branched from the upper nodes; leaves obviously petioled, the blades sharply toothed **S. tenuifolia**
7. Leaf blades wider, rounded, oblong to elliptic.
11. Petioles poorly developed, essentially absent.
12. Upper stem sides glabrous **S. hispida**
12. Upper stem sides variously pubescent, glandular and/or eglandular.
13. Corollas purple; rare adventive (AL) **S. palustris**
13. Corollas pink; native species.
14. Blades copiously pubescent, scabrous to merely felty; rare in SEUS, adventive in VA from north and west **S. arenicola**
14. Blades pubescent, but never scabrous or felty; higher elevations, KY-TN-GA-AL-SC **S. nuttallii**
11. Petioles obvious, frequently 1/5 the length of the blade.
15. Leaf blades dentate or sharply dentate; stem angles abundantly pubescent with spreading or somewhat retrorse, long (to 3 mm) hairs **S. clingmanii**
15. Leaf margins crenate to serrulate, but never dentate; stem angles glabrous or pubescent (if the latter, then with scattered, stiffish, retrorse hairs).
16. Annual; corolla scarcely exserted from calyx; LA-MS-AL-FL-SC **S. agraria**
16. Perennial; corolla prominently exserted from calyx; widespread.
17. Plants commonly glandular on stems, leaves, and within inflorescence.
18. Plant producing thick, segmented, tuber-like rhizomes; blades oblong; [weedy, mostly of coastal plain **S. floridana**
18. Plant rhizomatous, but not producing thick, tuberous thickening of rhizomes; blades elliptic, cordate; not weedy [higher elevations, mostly mountains, KY-TN-GA-AL-SC **S. nuttallii**
17. Plants not glandular on stems, leaves, and within inflorescence.
19. Calyx usually abundantly pubescent with stiff, eglandular hairs; fruiting calyx lobes straight, terminally apiculate **S. hispida**
19. Calyx usually glabrous to sparingly pubescent; fruiting calyx lobes frequently curved or curling/retrorse, not at all or only weakly apiculate **S. tenuifolia**

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BOOK REVIEWS

A. Michael Powell, James F. Weedin, and Shirley A. Powell. 2008. **Cacti of Texas: A Field Guide, with Emphasis on the Trans Pecos Species.** (ISBN-13: 978-0-89672-611-6, pbk.). Texas Tech University Press, 2903 4th Street, Box 41037, Lubbock, Texas 79409-1037, U.S.A. (**Orders:** www.ttup.ttu.edu, 800-832-4042). $24.95, 383 pp., 314 color photographs, 124 maps, 9" × 6".

"The Grover E. Murray Studies in the Southwest" has helped to produce one more fabulous effort from Michael Powell and company. This beautiful field guide is the companion publication to *Cacti of the Trans Pecos & Adjacent Areas* (Powell et al. 2004). Both books have a bit more emphasis for species in the Trans Pecos region. This new field guide is a soft cover that is well made, serving as a quick reference for cacti throughout Texas with keys, names, characteristics, habitat description, population distribution, and a color plate for almost every species documented. The earlier treatment of 2004 is a systematic documentation of the Trans Pecos species of Cactaceae and goes into much more detail about the taxonomy, biology, chemistry, and genetics. *Cacti of Texas* now provides an excellent reference for a very challenging subject in a state with more cactus species than anywhere else in North America.—*Justin Allison, Research Associate, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

Cacti of Texas is a somewhat technical field guide with unusually good pictures. These bright, attractive photographs are so well organized that someone who knew nothing about cacti could quickly find the place where his cactus is discussed. Beginning with tall, narrow and branching cacti, commonly known as "chollas," the cacti become gradually shorter and rounder (one dimension at a time), and at the same time spinier and spinier. Finally, on pages 264-266, we come to some cacti that are so round and so spiny that they look like snowmen—members of the genus *Epilantha*. Then the cacti grow longer, thinner and less spiny again, as well as becoming more like bushes instead of cacti. At the very end, we have *Pereskia aculeata* (lemonvine), which is almost spineless.

For those who are familiar with botanical terms related to cacti, there is a page on every species and variety. The scientific name and its origin are given, along with the places in Texas where the plant can be found. Then the appearances of the stem (or pad), spines, flowers, fruits and seeds are discussed in detail. I recommend the glossary.

Cacti of Texas has a picture and description of almost every cactus that grows in Texas, with a small map showing where in the Trans-Pecos region they grow most often. It is a very good guide for identifying wild cacti. Too bulky for a pocket, it will fit into most purses and all backpacks. It is aimed at advanced students.—*Kalisi Waterman, Junior Intern, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

GUTIERREZIA ELEGANS SP. NOV. (ASTERACEAE: ASTEREAE), A SHALE BARREN ENDEMIC OF SOUTHWESTERN COLORADO

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ABSTRACT

Gutierrezia elegans Al Schneider & P. Lyon, sp. nov., is described from outcrops of grayish, argillaceous Mancos Shale in southwestern Colorado. The new species is known only from several populations in and around the developing Lone Mesa State Park in Dolores County, where it is represented by at least 4000 plants. The plants are low, compact subshrubs with woody caudex branches and decumbent-ascending, evenly leafy stems, short-pedunculate heads in congested corymboid clusters, and short, 3-nerved leaves.

RESUMEN

Se describe **Gutierrezia elegans** Al Schneider & P. Lyon, sp. nov., de los afloramientos arcillosos grisáceos de Mancos Shale en el suroeste de Colorado. La nueva especie se conoce sólo de algunas poblaciones en el Lone Mesa State Park y sus alrededores, en el condado de Dolores, donde está representada por al menos 4000 plantas. Las plantas son subarbustos bajos, compactos con ramas caulinares leñosas, y tallos con hojas decumbente-ascendentes, cabezuelas cortamente pedunculadas en racimos corimboides congestos, y hojas cortas trinerviadas.

Biological exploration of the developing Lone Mesa State Park in Dolores County, Colorado, has brought to light a previously unknown species of *Gutierrezia*.

Gutierrezia elegans Al Schneider & P. Lyon, sp. nov. (**Figs. 1, 2**). Type: UNITED STATES. Colorado. Dolores Co.: Lone Mesa State Park, S end of the park, ca. 23 mi N of the town of Dolores, T39N, R14 W, Section 35, ca. 108° 28'W, 37° 41'N, exposure of Mancos shale, ca. 2% slope, 7575 ft, with dominants *Helianthella microcephala*, *Tetraneuris acaulis*, and *Eriogonum lonchophyllum*, abundant *Gutierrezia elegans*, *Petradoria pumila*, *Astragalus missouriensis* var. *amphibolus*, and *Heterotheca villosa*, scattered *Calochortus nuttallii*, *Delphinium nuttallianum*, *Othocarpus purpureoalbus*, *Physaria pulvinata*, *Packera oödes*, *Solidago simplex*, and others, *Pinus ponderosa* with pinyon-juniper on nearby surrounding slopes, 23 Aug 2008, *A. Schneider G-1, with members of the Colorado Native Plant Society* (holotype: COLO; isotypes: ASC, ASU, BRY, KHD, MO, NMC, NY, RM, TEX, US, UNM, UVSC).

Differt a *Gutierrezia pomariensi* (S.L. Welsh) S.L. Welsh caulibus brevioribus decumbentibus vel ascendentibus, capitulis minoribus in inflorescentiis congestis dispositis, et foliis trinerviis.

Subshrubs from a woody taproot with short-branched woody caudex branches, plants growing vertically 7.5–12.5(–15) cm high. **Stems** decumbent-ascending, 8–15 cm long, moderately hirtellous. **Leaves** alternate, sessile, basal absent at flowering, cauline evenly distributed, blades linear-lanceolate to linear-oblanceolate, mostly 10–16 mm × 2–3 mm, primarily 1-nerved but with a distinct pair of narrower lateral nerves, slightly or not all reduced in size distally, margins entire, surfaces and margins hirtellous. **Heads** borne mostly in congested corymboid clusters of 2–8, sometimes solitary, peduncles 1–6 mm or rarely to 20 mm from proximal branches of the capitulescence. **Involucres** turbinate-campanulate, 3–4 mm long, 2.5–3 mm diam. **Phyllaries** lanceolate-oblong, proximal 4/5 white-indurate, apices triangular to ovate with acute to obtuse tips, green, thickened, gland-dotted. **Ray florets** 6–8, fertile, corollas yellow, 3–5 mm long, laminae coiling at maturity. **Disc florets** 6–9, yellow, fertile. **Cypselae** cylindric, 1–2 mm long, faces without oil cavities, sparsely short-strigose; pappus of 1–2 series of persistent, oblong-lanceolate scales 1–1.5 mm long. **Chromosome number** unknown.

J. Bot. Res. Inst. Texas 2(2): 771 – 774. 2008

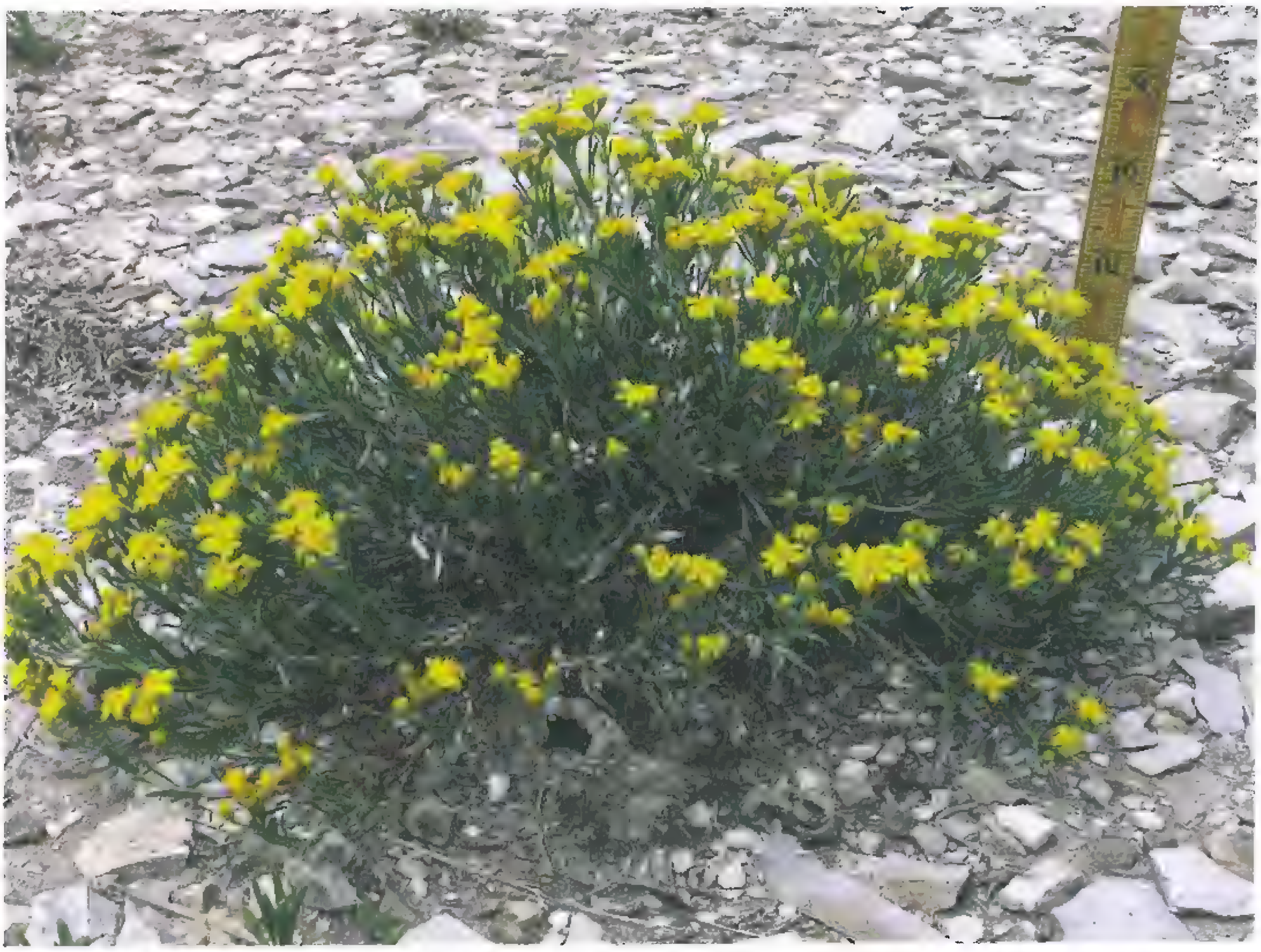

Fig. 1. Growth habit and habitat of *Gutierrezia elegans* (photo by Al Schneider).

Flowering late July through early September. Bare Mancos shale outcrops and thin soil over shale, *Gutierrezia elegans* scattered to abundant in the barrens and also occurring with *Artemisia nova* and other species in sites with deeper soil over the shale, *Pinus ponderosa* and pinyon-juniper on surrounding slopes; 7575–7600 ft (ca. 2500–2550 m). Apparently endemic to southwestern Colorado.

Additional collections examined: Colorado. Dolores Co.: Lone Mesa State Park, type locality, 4 Aug 2008, *Schneider and Lyon s.n.* (TEX); Lone Mesa State Park, S end of the park, ca. 23 mi N of the town of Dolores, T39N, R14 W, Section 23, ca. 108° 28'W, 37° 42'N, sandy soil over shale, 80% vegetation cover, dominant *Artemisia nova* and *Astragalus haydenianus* with *Artemisia ludoviciana*, *Eriogonum alatum*, *Eriogonum racemosum*, *Penstemon caespitosum*, *Astragalus missouriensis* var. *amphibolus*, *Heterotheca villosa*, *Pascopyrum smithii*, and *Chryosothamnus depressus*, slopes 8%, SSE-facing, *Pinus ponderosa* on surrounding slopes, 7600 ft, 23 Aug 2008, *Schneider G-2, with members of the Colorado Native Plant Society* (COLO, TEX).

Common name.—Lone Mesa Snakeweed.

Etymology.—We have chosen the specific epithet "elegans" because it summarizes so many of the most obvious visual characteristics of this new species. *Gutierrezia elegans* is delicate with masses of brilliant yellow flowers topping gracefully arching stems that form into a low, domed symmetry. In short, the plant is elegant.

Gutierrezia elegans is highly distinctive among all its congeners (Lane 1985), especially in its low, subshrubby habit with decumbent-ascending, evenly leafy stems, short-pedunculate heads in congested corymboid clusters, and short, 3-nerved leaves. It presumably may be most closely related to the group of species with a subshrubby habit, deciduous basal leaves, and heads mostly pedunculate and in relatively open arrays (vs. the subshrubby *G. sarothrae* (Pursh) Britt. & Rusby and *G. microcephala* (DC.) A. Gray, which have heads mostly sessile or subsessile, in glomerules, often in broad, dense, flat-topped arrays). Additional color pho-

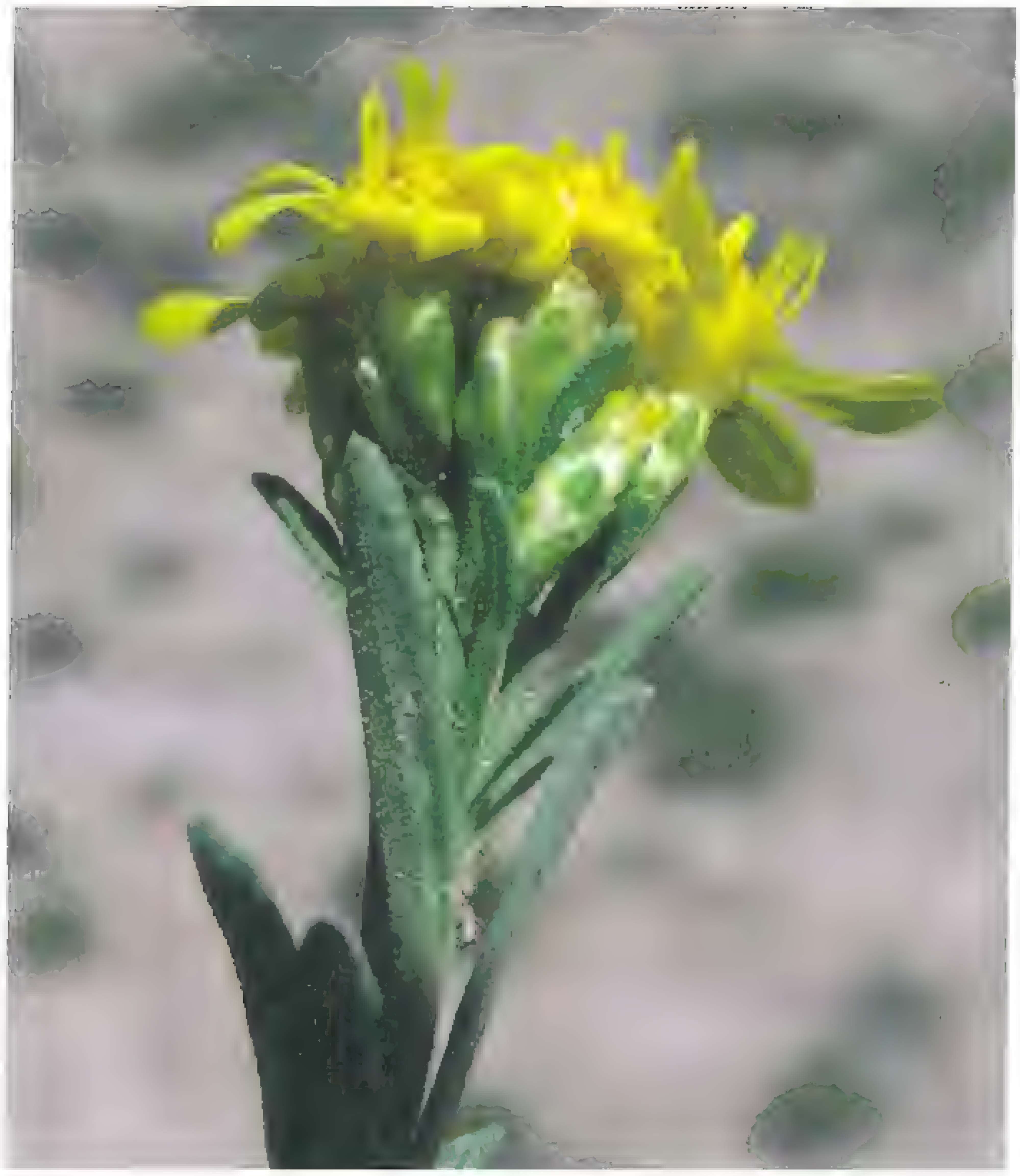

Fig. 2. Cluster of heads, *Gutierrezia elegans* (photo by Al Schneider).

tos of the new species and its habitat are posted on Southwest Colorado Wildflowers, Ferns, & Trees (Schneider 2008). The following key, which identifies *G. elegans* in the context of similar species, is adapted from the FNANM treatment of *Gutierrezia* (Nesom 2006).

1. Perennial herbs; basal leaves persistent; ray corollas 5–8(–10) mm; disc florets 15–23; Utah ______ **Gutierrezia petradoria** (Welsh & Goodrich) S.L. Welsh
1. Subshrubs; basal leaves not persistent; ray corollas 2–7 mm; disc florets 5–15(–17); Arizona, Colorado, Utah, California.
    2. Phyllary apices thickened; cypselae strigose; Colorado and Utah.
        3. Stems 8–15 cm long, decumbent-ascending; heads mostly in congested corymboid clusters of 2–8, sometimes solitary, peduncles 1–6 mm or rarely to 20 mm from proximal branches of the inflorescence; leaves mostly 10–16 mm long, 3-nerved; involucres 3–4 mm long; Colorado ______ **Gutierrezia elegans** Al Schneider & P. Lyon
        3. Stems mostly 20–50 cm long, erect to ascending-erect; heads in open corymbs, peduncles mostly 10–40 mm long; leaves mostly 20–40(–60) mm long, 1-nerved; involucres 5–8 mm long; Utah. ______ **Gutierrezia pomariensis** (S.L. Welsh) S.L. Welsh
    2. Phyllary apices not thickened; cypselae densely strigose-sericeous; Arizona and California.
        4. Stems glabrous; involucres campanulate (as long as wide); cypselae 1–1.2 mm; Arizona ______ **Gutierrezia serotina** Greene
        4. Stems glabrous or minutely hispidulous; involucres turbinate to cylindric-turbinate (longer than wide); cypselae 2–2.8 mm; California ______ **Gutierrezia californica** (DC.) Torrey & A. Gray

Lone Mesa State Park is situated in the Dolores River drainage, immediately north of the San Juan River drainage and thus was not included in the Four Corners Flora (Heil et al. 2008), although large areas of the

Mancos Shale also occur in the San Juan drainage. *Gutierrezia sarothrae* and *G. microcephala* are the only species of the genus treated in the Four Corners flora (Nesom 2008), and they also are the only two of the genus previously known from Colorado.

Gutierrezia elegans is known from five separate populations in and around Lone Mesa State Park, all within a radius of about three miles. It occurs on San Juan National Forest and Bureau of Land Management land adjacent to the state park. Among its known populations, we estimate that *G. elegans* is represented by a total of over 4000 plants. Plants of the new species at the type locality occur as well-separated individuals on very sparsely vegetated flats (slopes ca. 2%) and sides of shallow washes. They grow along cracks in the bare shale and in thin gravelly soil over the shale. Where the shale is not directly exposed, the new species is easily seen to grow in the "crack-lines" of the underlying rock. *Gutierrezia elegans* is among the more abundant species in this habitat. *Pinus ponderosa* occurs on nearby slopes.

At other localities, the soil is deeper and more sandy and *Gutierrezia elegans* occurs less commonly among other species in a more densely vegetated community dominated by *Artemisia nova*. *Gutierrezia elegans* is most abundant at the interface of the barren shale and surrounding sagebrush dominated areas, forming a rim around the barren patches. Also abundant here are *Artemisia ludoviciana*, *Heterotheca villosa*, *Achillea lanulosa*, *Eriogonum racemosum*, *Astragalus haydenianus* and various grasses, with *Pinus ponderosa* on surrounding slopes. This site is at 7800 feet elevation and has slopes of 6–8%.

The rare and recently discovered *Physaria pulvinata* (O'Kane & Reveal 2006) grows with *Gutierrezia elegans* on the shale outcrops within Lone Mesa State Park. The two species are similar in their many-branched caudex and caespitose, mound-forming habit. *Physaria pulvinata* also is known from similar shale barrens in the Miramonte State Wildlife Area of San Miguel Co., about 23 miles north of the Lone Mesa State Park. In addition to these two species, other endemics have been described from Mancos Shale habitats closely clustered in the Four Corners area: *Abronia bolackii* Atwood, Welsh, & Heil, *Proatriplex pleiantha* (W. Weber) Stutz & Chu, *Sclerocactus mesae-verdae* (Boissevain & Davidson) L.D. Benson, and *Xanthisma paradoxum* (Turner & Hartman) Nesom & Turner (New Mexico Rare Plant Technical Council 1999; Nesom & Turner 2007).

ACKNOWLEDGMENTS

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JUNCUS DIGITATUS (JUNCACEAE), A NEW ANNUAL RUSH FROM SHASTA COUNTY, CALIFORNIA, U.S.A.

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ABSTRACT

Juncus digitatus is an annual described from two localities in the foothills of the Cascade Range in Shasta County, California. It is separable from *Juncus triformis* by its later flowering period, linear fruits with an acuminate apex, longer capsules 11–17 mm; and fruits that are 3–4 times as long as the tepals. A key to *Juncus* section *Caespitosi* is provided for western North America.

RESUMEN

Juncus digitatus es una planta anual descrita de dos localidades del piedemonte de la cordillera de las Cascadas, en el Condado de Shasta, California. Es separable de *Juncus triformis* por su período de floración tardío, frutos lineares con un ápice acuminado, cápsulas más largas 11–17 mm; y tépalos 25–30% la longitud de los frutos. Se presenta una clave para *Juncus* sección *Caespitosi* para la región occidental de América del Norte.

Key Words: *Juncus digitatus*, *Juncus* section *Caespitosi*, California, Shasta County, vernal pools

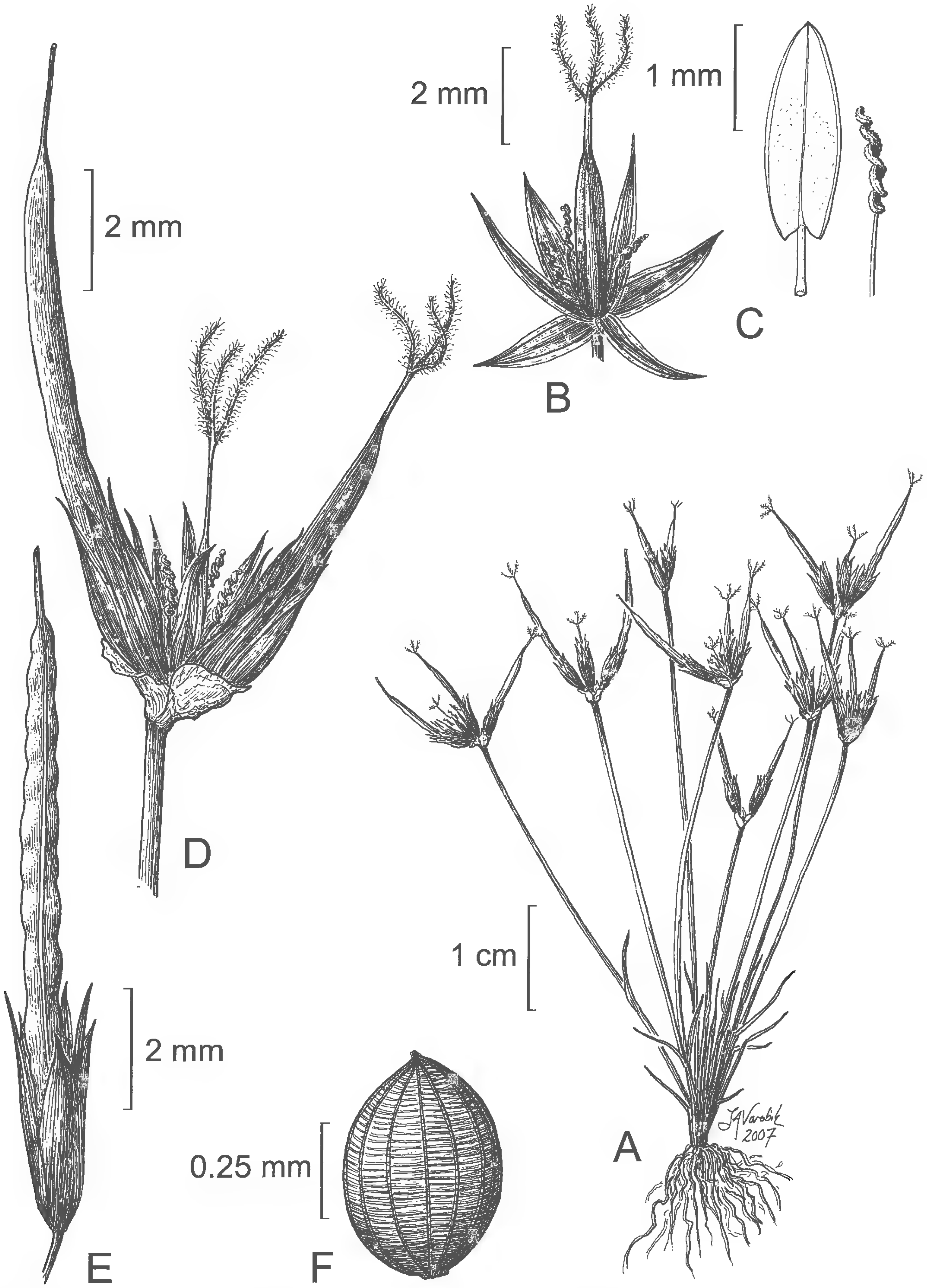
Juncus section *Caespitosi* Cout. is defined as a group of 16 delicate annuals primarily from South Africa and western North America (Kirschner et al. 2002a), alternatively included as annuals within subg. *Graminifolii* (Engelm.) Buchenau (e.g., Brooks & Clemants 2000). Eleven members of section *Caespitosi* are indigenous to California, including four endemics: *Juncus triformis* Engelm., *J. leiospermus* F.J. Herm. var. *leiospermus*, *J. leiospermus* var. *ahartii* Ertter, and *J. luciensis* Ertter (Ertter 1986; Swab 1993). An additional endemic is described here, first collected in 1991 by Dean W. Taylor.

Juncus digitatus C. Witham & Zika, sp. nov. (**Figs. 1–3**). Type: U.S.A. California. Shasta Co.: vernal pool about 10 air km NNE of Shingletown, 2 Jun 1993, *Carol W. Witham 481* (holotype: JEPS; isotypes: CAS, MO, OSC, RSA, WTU).

A *Junco triformi* capsulis linearibus acuminatis 11–17 mm longis differt.

Plants annual, 4–10.5 cm tall. **Leaves** essentially basal, sheaths 2–15 mm long, with broad scarious fragile margins tapering to the blade without auricles; blades filiform, 5–20 mm long, with acicular apex 0.2–0.5 mm long. **Stems** (culms) unbranched, 3–7 cm tall, 0.2–0.3 mm thick. **Bracts** often clustered like an involucre, 2–8, ovate or narrowly ovate, acute, scarious or dark purple towards base, 1–1.8 mm long. **Pedicels** 0.5–1.5 mm long. **Flowers** terminal, in clusters of (1–)2–8, trimerous. Tepals uniformly 6, narrowly lanceolate, 3.5–4.4 mm long, 0.6–0.7 mm wide, the inner (petals) usually 0.4–0.7 mm longer than the outer (sepals); midvein green with red border, 0.1–0.3 mm wide, often with scattered low papillae at 40×, the tips dark purple; with narrow pale margins 0.1–0.2 mm wide to the apex; tepal margins scarious; apex acuminate to attenuate, erect to slightly recurved at tip. **Stamens** 3, 2–2.5 mm long; filaments 0.6–0.8 mm long; anthers often somewhat sagittate-based, 1.1–2.1 mm long, ca. 2 times the length of the filaments. Style 1–1.5 mm long, elongating to 2.7 mm in fruit; stigmas (2)3, 1.6–5 mm long, reddish, exserted 1.5–3 mm beyond the tepals at anthesis. **Capsules** linear, often slightly curved, (2)3-valved, c. 3–4 times as long as the tepals, (7–)11.3–17 mm long, (0.4–)0.7–1 mm wide, brown to red or dark red to dark brown, similar in color to the tepals, the apex acuminate and gradually tapered into base of the persisting style. **Seeds** 9–20 per row and ca. 10–50 per capsule, ellipsoid to ovoid or narrowly ovoid, 0.5–0.65 mm long, 0.35–0.4 mm wide, shiny, dark brown, at 10× with 10–12 strong longitudinal striations and faint cross-striations, base blunt or with dark broad stipe 0.05 mm long, apex pale, short apiculate. Chromosome number unknown.

J. Bot. Res. Inst. Texas 2(2): 775 – 781. 2008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J.A. Varobik 2007

Fig. 1. *Juncus digitatus*. **A.** Habit. **B.** Flower, with exserted stigmas, erect anthers and spreading tepals. **C.** Anthers, fresh and old. **D.** Inflorescence with flowers and immature capsules. **E.** Mature capsule. **F.** Seed, with prominent longitudinal striations. (A-E drawn from *Witham 1259*; F from *Zika 23021 & Witham*.)

Etymology.—We have selected *digitatus*, a name that suggests the finger-like aspect of the unusual fruit clusters.

Paratypes: **U.S.A. CALIFORNIA. Shasta Co.:** Shingle Creek along Highway 44, 29 May 1991; *D.W. Taylor 11835* (JEPS, mixed sheet with *J. triformis*); same site, 20 May 1992, *C.W. Witham 443* (JEPS); same site, 27 May 1992; *D.W. Taylor 12657 & C.W. Witham* (JEPS); same site, 2 Jun 1993; *C.W. Witham 480* (CHSC, DAV, GH, JEPS, NY); same site, 3 Jun 1993, *D.W. Taylor 13561* (UC); same site, 18 May 2007, *C.W. Witham 1258* (DAV); same site, 4 Jun 2007, *P. F. Zika 23015 & C.W. Witham* (CAN, DAV, UC, US, WTU); Hamp Creek, 25 May 1993, *D.W. Taylor 13498* (JEPS, UC); same site, 18 May 2007, *C.W. Witham 1259* (DAV); same site, 4 Jun 2007, *P. F. Zika 23021 & C.W. Witham* (DAV, GH, MO, NY, PRA, RSA, UC, WTU).

DISTRIBUTION AND ECOLOGY

Juncus digitatus is known only from two populations in Shasta County, from the foothills of the Cascade Range at the northern end of the Sacramento Valley. Populations are in full sun, in the vernally damp ground of seeps, vernal pools, and swales on gentle slopes over volcanic bedrock, at elevations of 660–790 m. Its common associates include *Allium amplectens* Torr., *Centaurium venustum* (A. Gray) B.L. Rob., *Cyperus squarrosus* L., *Deschampsia danthonioides* (Trin.) Munro, *Epilobium pallidum* (Eastw.) Hoch & P.H. Raven, *Eryngium articulatum* Hook., *Isoetes nuttallii* A.Braun ex Englem., *Juncus bufonius* L., *J. acuminatus* Michx., *Mimulus guttatus* Fisch. ex DC., *Muhlenbergia richardsonis* (Trin.) Rydb., *Navarretia intertexta* (Benth.) Hook., *Odontostomum hartwegii* Torr., *Polygonum bolanderi* Brewer, and *Trichostema laxum* A. Gray. Surrounding forest is dominated by *Pinus ponderosa* Douglas ex Lawson & C.Lawson, *P. sabiniana* Dougl. ex D.Don, and *Quercus douglasii* Hook. & Arn.

One population of *Juncus digitatus* grows within a few meters of plants of *J. triformis*, although the two species vary in their flowering period and microsite preference. In the same vernal pool complex *J. triformis* prefers slightly drier positions and is in fruit when *J. digitatus* is in flower in mid-May. *Juncus digitatus* fruits in late May and early June.

RELATIONSHIPS

Juncus digitatus is most closely related to *J. triformis*, and the two have similar outcrossing pollination biology, with anthers much larger than the filaments, spreading tepals, and exserted stigmas when in bloom. Their habit, habitat, tepals, foliage and seeds are also similar; both species are in *Juncus* section *Caespitosi* and endemic to California. *Juncus triformis* capsules are 1–3 mm long, including the beak. *Juncus digitatus* is unique in the genus with its *Lotus*-like clusters of linear capsules 11–17 mm long. No other *Juncus* regularly have capsules more than 10–11 mm long, among the 315 species covered in the comprehensive catalogues of Kirschner (2002a, 2002b), Balslev (1996), or Brooks and Clemants (2000). *Juncus triformis* tepals generally exceed (rarely equal) the length of the capsule; in *J. digitatus* the mature capsule is about 3–4 times as long as the tepals. *Juncus digitatus* capsules are linear, often curved, and gradually tapered to the persistent style on the apex; in *J. triformis* the capsule is generally ovoid to ellipsoid, and the apex is usually abruptly tapered to the persisting style base.

Our field work found that *J. triformis* is absent at one of the two populations of *J. digitatus*. This is significant, demonstrating that the two species retain their morphological differences in the same habitat, or when growing isolated from each other (Wagner & Wagner 1983). Intermediates are not known. This mingling in some sites without intermediates, and growing isolated elsewhere, parallels the situation among a number of other western North American species of *Juncus* section *Caespitosi* reported in Ertter (1986) and supports our argument that *J. digitatus* should be treated at the rank of species.

Ertter (1986) points out that *Juncus triformis* is unusually variable in several morphological features, including "coloration, shape, and relative proportions of inner tepals, outer tepals, capsules, and seeds." Hermann (1948) was unaware of this extensive and continuous morphological gradation, and split from *Juncus triformis* high elevation plants with relatively slender culms and large seeds, which he called *J. megaspermus* F.J. Herm. After reviewing the variation in specimens of *J. triformis* from across California, using the collections at CAS, CHCS, DS, GH, JEPS, OSC, POM, RSA, UC, UCR, and WTU, we agree with Ertter

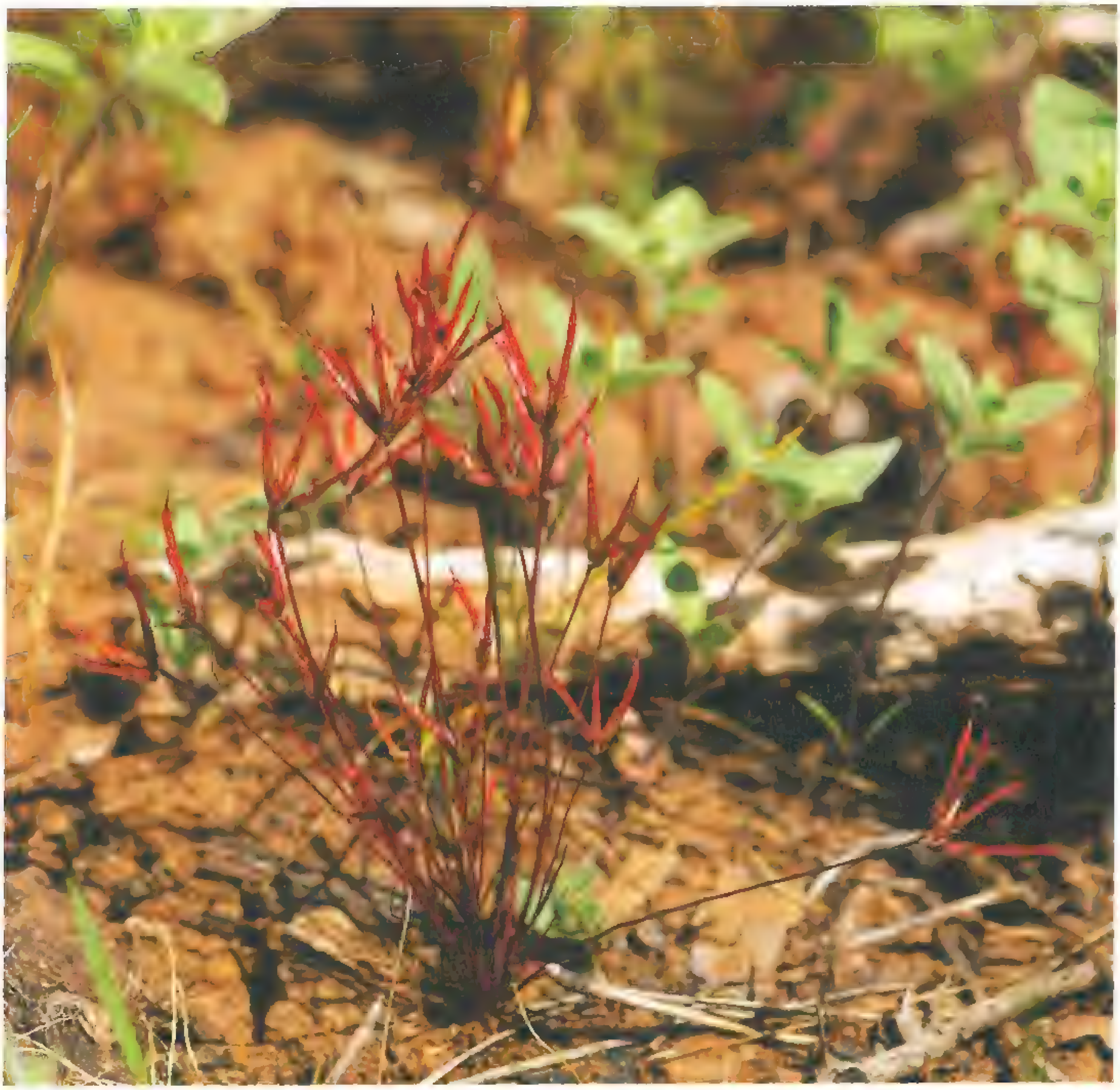

Fig. 2. Photo of *Juncus digitatus* habit.

(1986) and Kirschner (2002a) that the type of *J. megaspermus* is not a significant variant and belongs in the synonymy of *J. triformis*. Nor have we found any other name in the synonymy of *J. triformis* that would apply to and have priority over *J. digitatus*.

A key to annual *Juncus* with simple stems and terminal flowers in North America is provided to aid in identification of the species. Mature capsules and ripe seeds are essential.

KEY TO *JUNCUS* SECTION *CAESPITOSI* IN NORTH AMERICA

1. Lower inflorescence bracts prominent, erect, appearing to be a continuation of the stem, much longer than the inflorescence; outer tepals long-acuminate, much longer than acute to blunt inner tepals; Eurasian introduction ____ **J. capitatus** Weigel

1. Lower inflorescence bracts inconspicuous, not erect, much shorter than the inflorescence; outer tepals similar in shape and length to inner tepals, sometimes inner tepals longer than outer tepals; native to western North America.
   2. Anthers 0.9–3.2 mm long, longer than filaments, styles 0.9–4 mm long (flowers outcrossing).

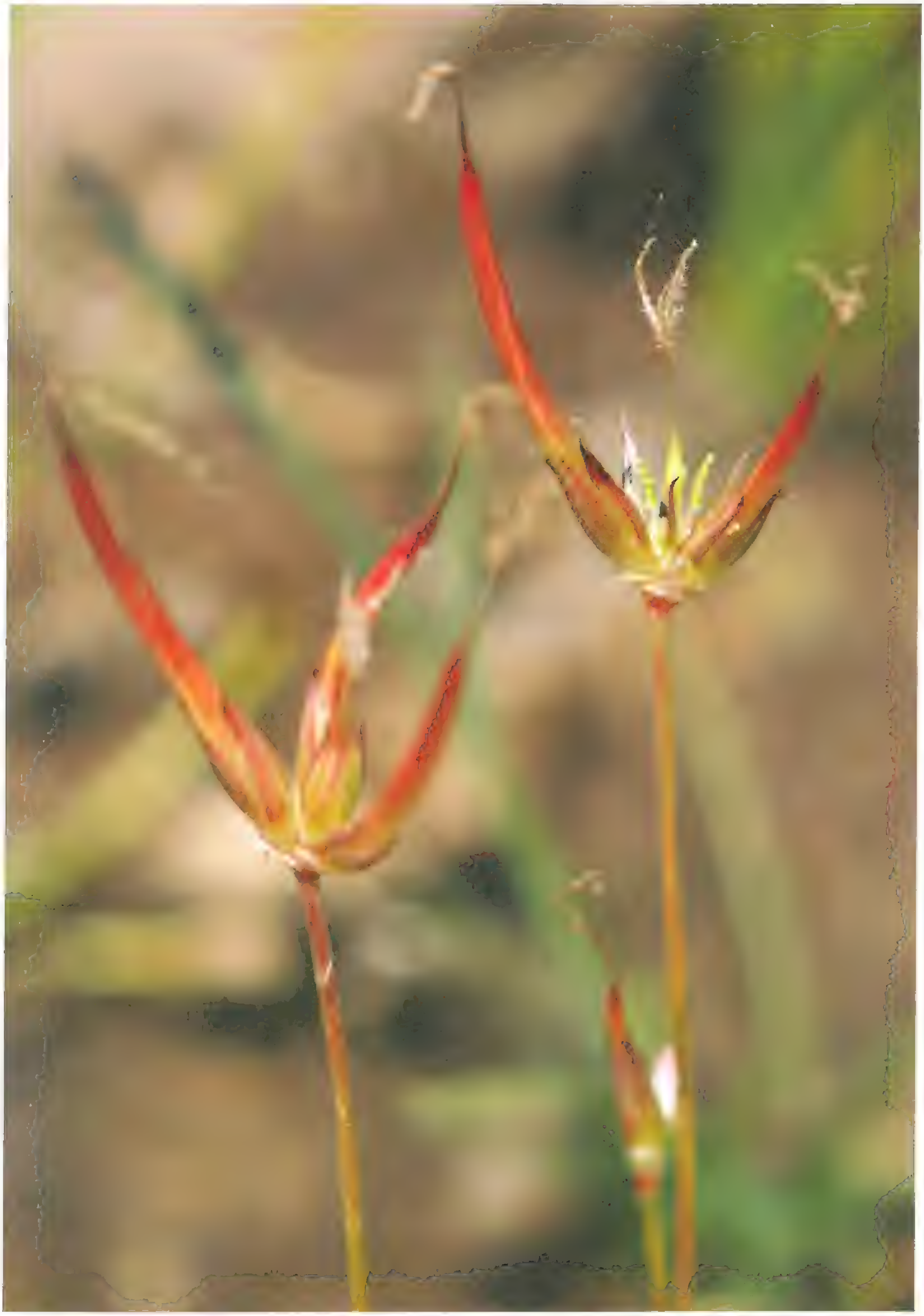

Fig. 3. Photo of *Juncus digitatus* flower and immature capsules.

3. Capsules 11–17 mm long, about 3–4 times as long as tepals **J. digitatus** C. Witham & Zika
3. Capsules 1–5 mm long, shorter than or about as long as tepals.
4. Tepals acuminate; seed longitudinally striated (at 15×); inner tepals colored to apex; inner tepal margins narrowly scarious **J. triformis** Engelm.
4. Tepals acute; seed not longitudinally striated; inner tepals not colored to apex, both inner and outer tepal margins broadly scarious **J. leiospermus** F.J. Herm.
5. Flowers usually solitary (rarely 2) per stem **J. leiospermus** var. **ahartii** Ertter
5. Flowers usually 2–4 (rarely 7) per stem **J. leiospermus** var. **leiospermus**
2. Anthers 0.15–0.5 (0.8) mm long, shorter than filaments, styles 0–0.5 mm long (flowers self-pollinating).
6. Seeds longitudinally striated (at 15×); flowers 1–2 (rarely 7) per stem; bracts 2, acute to acuminate.
7. Tepals usually 4.
8. Mature capsule usually subglobose, shorter and sometimes paler than tepal tips; seeds 0.5–0.8 mm long; 2–3 seeds per locule, 4–9 seeds per capsule **J. capillaris** F.J. Herm.
8. Mature capsule elliptic to oblong, usually equaling or longer than similarly colored tepals; seeds 0.4–0.5 mm long; 4–7 seeds per locule, 10–30 seeds per capsule **J. tiehmii** Ertter
7. Tepals usually 6.
9. Tepals usually longer and darker than the capsule; 4–9 seeds per capsule; longitudinal ridges on seeds often faint even at 30×; seeds 0.5–0.8 mm long **J. capillaris** F.J. Herm.
9. Tepals usually shorter and the same color as the capsule; 40–50 seeds per capsule; longitudinal ridges on seeds well-developed at 30×; seeds 0.3–0.6 mm long.
10. Stems usually with 2–3 (rarely 1 or 4) flowers; capsule and tepals ultimately dark reddish; seeds 0.4–0.6 mm long **J. kelloggii** Engelm.
10. Stems usually with solitary (rarely 2) flowers; capsule and tepals ultimately pale yellowish-green (tepal midveins dark red distally); seeds 0.3–0.4 mm long **J. luciensis** Ertter
6. Seeds not longitudinally striated; flowers solitary; inflorescence bracts absent or 1–2, truncate to acute.
11. Inflorescence bracts absent; stem thickened below flower **J. hemiendytus** F.J. Herm. var. **abjectus** (F.J. Herm.) Ertter
11. Inflorescence bracts 1–2; stem filiform, not thickened below flower.
12. Inflorescence bracts solitary, apex truncate, sheathing stem; stamens 2–3 **J. uncialis** Greene
12. Inflorescence bracts 1–2, apex acute to blunt, not sheathing stem; stamens 2–4.
13. Tepals usually 6, shiny, incurved and longer than capsule; inflorescence bracts 2 **J. bryoides** F.J. Herm.
13. Tepals usually 4, dull, erect or slightly outcurved and usually shorter than capsule; inflorescence bracts 1–2 **J. hemiendytus** var. **hemiendytus**

CONSERVATION CONCERNS

Juncus digitatus joins a list of narrow endemics restricted to Shasta County, including *Ageratina shastensis* (D.W. Taylor & Stebbins) R.M. King & H. Robins., *Ivesia longibracteata* Ertter, *Neviusia cliftonii* Shevock, Ertter & D.W. Taylor, and *Puccinellia howellii* J.I. Davis. Like *Juncus digitatus*, several Shasta County endemics are rare and have conservation issues. Due to the small populations and the restricted geographic extent of *Juncus digitatus*, we have not provided exact locality data. The lead author has invested many field seasons searching for this species, without adding more localities. Certainly more study and inventory is needed. Nonetheless *J. digitatus* seems an appropriate candidate for attention from the conservation community, as a narrow endemic on private lands in one county, in a wetland habitat that has been largely converted into agriculture or rangeland. About half the available habitat at the Hamp Creek population has been lost in recent years to a piped diversion of spring water.

ACKNOWLEDGMENTS

We would like to thank Barbara Ertter for prompting us to investigate this plant. We are grateful to Lowell Ahart, Ed Alverson, Jan Kirschner, Frank Lang, Jim Nelson, Julie Nelson, and Dean W. Taylor for assistance, to Ken Chambers for the Latin diagnosis, to Amanda Jorgenson for the Spanish abstract, to Linda Vorobik for the artwork, and to the curators of the cited herbaria for loans or access to specimens. Steve Clemants, Barbara Ertter and Jan Kirschner kindly reviewed and improved our manuscript. We thank the California

Native Plant Society and its Sacramento Valley and Shasta Chapters, and the Lawrence R. Heckard Fund of the Jepson Herbarium for grants which covered some of our expenses.

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BOOK REVIEW

Sylvain Beausejour, with foreword & English translation by Paul Martin Brown. 2008 (expected). **Orchidees Indigenes du Quebec/Labrador (Native Orchids of Quebec/Labrador).** Les éditions Native, 645 Boul. Manseau, Joliette, Quebec J6E 3E7 Canada. (**Orders:** http://orchideequebec.com/eng/index.html, info@nativeorchidsamerica.com, 450-755-2560; also available from Orchid Books, www.orchidsbooks.com). $49.99 (CAD), $42.33 (USD), 176 pp., 380 illus., 9 3/4" × 11 3/4".

The past few years have seen several new books relating to the wild orchids of Canada. They have essentially been field guides and vary from slender paperbacks on Newfoundland and Manitoba to the more extensive *Wild Orchids of the Canadian Maritimes and Northern Great Lakes*. After many years of painstaking photography and research, Sylvain has produced what is unquestionably the most beautiful book on the orchids of northern North America. Neither a field guide nor a botanical treatise, *Orchidees indigenes du Quebec/Labrador (Native Orchids of Quebec/Labrador)* is a feast for the eyes of the most artistic photographs to come along in many years. Each species is treated with numerous photos as well as the pertinent technical information and a map showing the general distribution in the region. Habitat photographs abound, and extreme close-ups are the rule rather than the exception for each species. Sylvain's expertise as a photographer is unquestioned, but his dedication to finding all of these orchids is bordering on the fanatical. I have been privileged to help him in locating some of the species, many of which required multiple trips of great distances, and then as the book was nearing completion, I provided the English translation to give the book a larger audience. It was a special experience that I had not attempted before. Be sure to check Sylvain's website for a unique preview of the book.

Orchidees indigenes du Quebec/Labrador (Native Orchids of Quebec/Labrador) has had a frustrating history of publication as the first printing in November 2007 was so poorly bound that Sylvain refused delivery and returned the books, and then after many months of negotiations and broken promises, has finally received the books. And they are spectacular. The large format, heavy papers, and brilliant colors all contribute to this superior volume. Although certainly biased in favor of the book, I highly recommend it to all native orchid enthusiasts, and as it is a private printing the run will sell out soon. Can we now look forward in the future to a companion publication by Sylvain on the orchids of Ontario?—*Paul Martin Brown, 10896 SW 90th Terrace, Ocala, Florida 34481, U.S.A., naorchid@aol.com.*

TWO NEW SUBSPECIES OF *SIDALCEA HICKMANII* (MALVACEAE) IN CALIFORNIA

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ABSTRACT

Revised treatments for *Sidalcea* for the upcoming Second Edition of the *Jepson Manual* and the *Flora of North America* have led to the discovery of several additional taxa. **Sidalcea hickmanii** subsp. **napensis** and subsp. **pillsburiensis** are described as new from northern California. As with the other four described subspecies, the two new taxa are found in very small isolated populations in upland areas of open chaparral vegetation, the former from Napa County, and the latter from Lake County. They may represent relict populations. Unlike most other populations of the species, the two new taxa are not necessarily associated with serpentine. The two new subspecies, and the others, may be vulnerable to grazing, foraging and human-caused changes in their environments.

Key Words: California, *Sidalcea hickmanii*, Malvaceae, North America, rare plants

RESUMEN

Los tratamientos de *Sidalcea* para la segunda edición del *Jepson Manual* y la *Flora of North America* han llevado al descubrimiento de varios taxa adicionales. Se describen **Sidalcea hickmanii** subsp. **napensis** y subsp. **pillsburiensis** como nuevos del norte de California. Tal como ocurría con las otras cuatro subespecies descritas, los dos nuevos taxa se encuentran en poblaciones aisladas muy pequeñas en áreas altas con vegetación de chaparral abierto, la primera del condado de Napa, y la segunda del condado de Lake. Pueden representar poblaciones relictas. Al contrario que la mayoría de las otras poblaciones de la especie, los dos nuevos taxa no están necesariamente asociados con serpentinas. Las dos nuevas subespecies, y las otras, pueden ser vulnerables al pastoreo y cambios antrópicos en sus medios.

INTRODUCTION

Sidalcea hickmanii Greene has long been known to exist in only a few widely scattered isolated populations, generally on serpentine (Roush 1931; Hitchcock 1957), and the survival of these populations appears to be dependent on occasional fires. Until recently, the species was thought to be a California endemic, but the discovery of a population in southern Oregon, yet to be fully studied, has shown that this is not the case (Halse, pers. comm.). This distribution can be interpreted as relictual for a species formerly more widely distributed that has become separated into several isolated parts, each part subsequently diverging through inbreeding. Work by Andreasen and Baldwin (2001) suggests that the species is not only basally divergent within the genus but that it 'evolved significantly more slowly than most of the other perennials'. Previously, four subspecies of *S. hickmanii* have been described; namely, the typical subspecies, subsp. *hickmanii*, restricted to the Santa Lucia Mountains in Monterey County; subsp. *anomala* C.Hitchc., restricted to the region of Cuesta Pass in San Luis Obispo County; subsp. *parishii* (Robinson) C.Hitchc., known from a few sites in San Bernardino and Santa Barbara cos.; and subsp. *viridis* C.Hitchc., restricted to Big Carson Ridge in Marin County. Reports of the species in Sonoma County have not yet been substantiated and several coastal specimens examined from that county that had been reported as this plant were actually *S. malviflora*. Specimens of unusual individuals of *S. hickmanii* at three sites have been brought to my attention by their discoverers since the publication of the most recent treatment of the genus in the *Jepson Manual* (Hill 1993). An examination of the specimens and images of these plants led me to the conclusion that two new Californian subspecies of this distinctive species needed description.

Sidalcea hickmanii Greene subsp. **napensis** S.R. Hill, subsp. nov. (**Fig. 1**) Type: U.S.A. California. Napa Co.: W of Leoma Lakes at base of Mt. George, elevation 1380 ft; Mt. George quad., T6N, R3W, NE/4 of NE/4 Sec. 29; chaparral, on brushy

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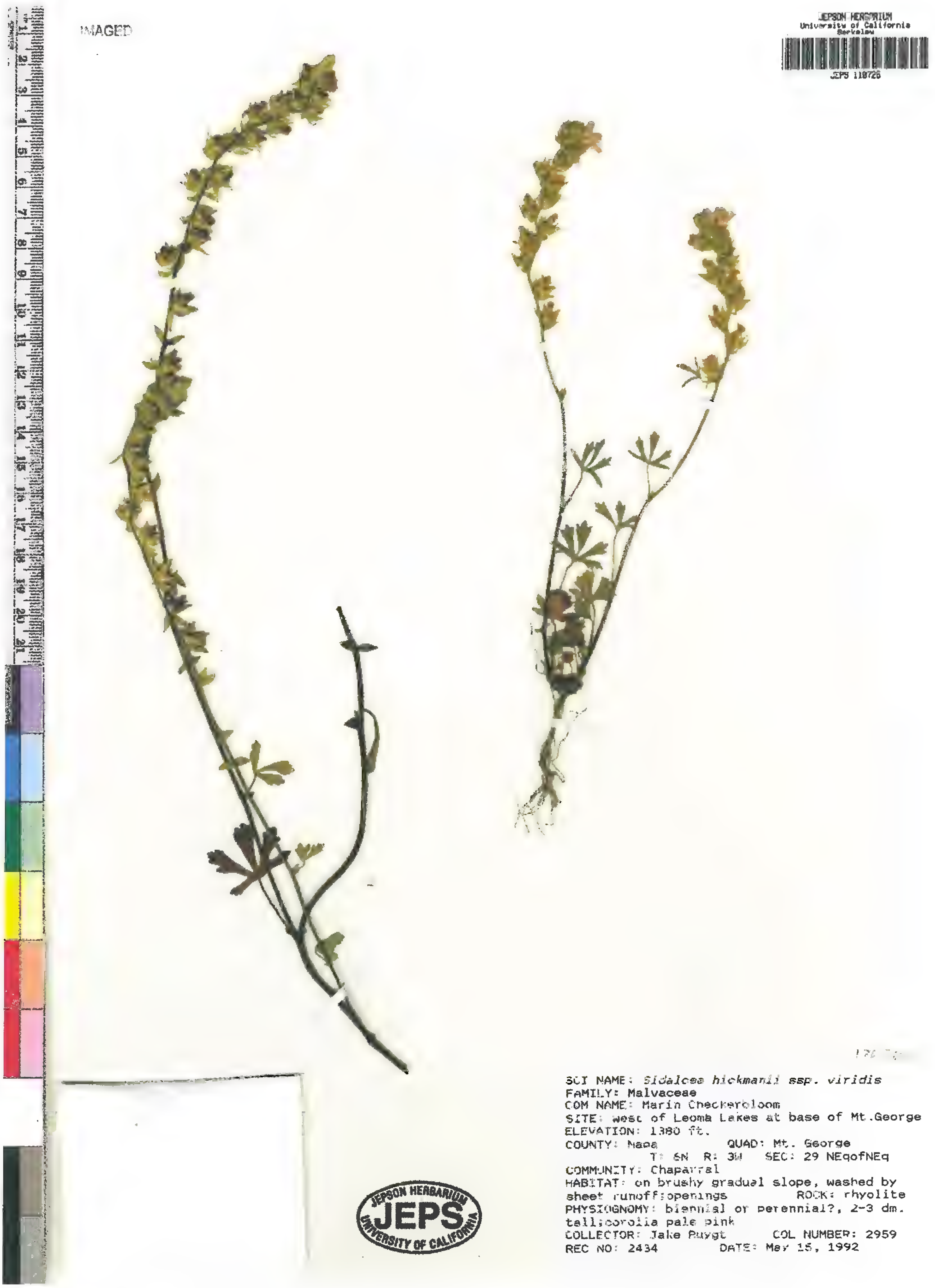
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SCI NAME: *Sidalcea hickmanii ssp. viridis*
FAMILY: Malvaceae
COM NAME: Marin Checkerbloom
SITE: west of Leoma Lakes at base of Mt.George
ELEVATION: 1380 ft.
COUNTY: Napa QUAD: Mt. George
T: 6N R: 3W SEC: 29 NEqofNEq
COMMUNITY: Chaparral
HABITAT: on brushy gradual slope, washed by sheet runoff;openings ROCK: rhyolite
PHYSIOGNOMY: biennial or perennial?, 2-3 dm. tall;corolla pale pink
COLLECTOR: Jake Ruygt COL NUMBER: 2959
REC NO: 2434 DATE: May 15, 1992

Fig. 1. Holotype of *Sidalcea hickmanii* Greene subsp. *napensis* S.R. Hill, subsp. nov., *Jake Ruygt 2959*, 15 May 1992 (JEPS 110725).

gradual slope washed by sheet runoff; openings; rhyolite, biennial or perennial?, 2–3 dm tall; corolla pale pink, 15 May 1992, *J. Ruygt 2959* (HOLOTYPE: JEPS 110725!).

Herba perennis e caudicem erectum parvum, radice palari elongato. Caules pauci erecti, ± 20–30(–40) cm, saepe rubelli, pubescentes pilis stellatis caespitosis dispersis simplicibusque. Folia pauca (< 6 per caulem) pubescentia pilis stellatis; folia mediana petiolis 10–25 mm longis, flexis in summis 2.5–3 mm; laminis latitudine plus quam longitudine, 10–17(–20) mm longis × 15–25(–34) mm latis, 3–5(–7)-lobatis palmatim prope basim, lobis dentatis profundis; stipulis ovatis, 5–6 mm longis × 2–3 mm latis, 3–5-nervatis, ciliatis; folia basi crenata interdum. Inflorescentia racemus spiciformis, floribus dispersis 2-bracteatis, bracteis similis stipulis sed pubescentioribus, bracteolis 3 persistentibus, 5–6 mm longis × 0.7–1.0 mm latis, calycibus 7–10 mm longis × 11–12 mm latis, pubescentibus dense, pilis stellatis, lobis ciliatis; petalis roseis pallidis 9–11(–15) mm longis × 6–9 mm latis. Fructus schizocarpium, 6–7-mericarpiis 2 mm altis × 2.0–2.5 mm longis × 1.5–1.8 mm latis, parietibus lateralibus laevibus, dorsis marginibusque 2–5-corrugatis-sinuatis, stria mediano in dorso; cuspide (mucrone) 0.

Perennial herb from a small erect caudex, generally with an elongated taproot or rootstock. Stems few, erect (to slightly ascending), ± 20–30(–40) cm tall, often tinted reddish (maroon), pubescent with scattered tufted stellate hairs and a few simple hairs. Leaves few (< 6 per stem), pubescent with gen 6-rayed stellate hairs; mid-stem leaves with petioles 10–36 mm long (to 6 cm on lower leaves), bent in the uppermost 2.5–3 mm (this portion pulvinus-like); blades wider than long, 10–17(–20) mm long × 15–25(–34) mm wide, palmately 3–5(–7)-lobed nearly to the base, the cuneate lobes deeply few-toothed; stipules ovate, persistent, 5–6 mm long × 2–3 mm wide, 3–5-nerved, ciliate; a few leaves at the base occasionally deeply crenate. Inflorescence a spiciform raceme, flowers scattered below, overlapping above, pedicels ca. 2 mm long, subtended by 2 bracts similar to the stipules but more pubescent, 5.5–7 mm long; bractlets 3, persistent, 5–6 mm long × 0.7–1.0 mm wide; calyx 7–10 mm long × 11–12 mm wide, densely pubescent with stellate hairs, lobes ciliate; petals pale pink, 9–11(–15) mm long × 6–9 mm wide. Fruit a schizocarp with 6–7 mericarps 2 mm tall × 2.0–2.5 mm long × 1.5–1.8 mm thick, with smooth lateral walls, the back and margins with 2–5 wavy corrugations, single median line on back, cusp (mucro) 0.

The paratypes I have cited below include all other collections I have examined, most of which were collected at the same site. A single robust specimen with 8 main flowering stems and a caudex 3 cm wide was collected in 1942 at a second site west of St. Helena, but the current status of this population, as well as other specific details, are unknown. On 7 May the lowermost flowers in the spikes had just opened. Habitat information for the known extant population at the base of Mt. George suggests *S. hickmanii* subsp. *napensis* is a plant of open mixed and chamise chaparral in rocky rhyolitic soils, at an elevation of 421 (417–427) m (1380 ft; 1370–1400 ft). The total number of plants is incompletely known, but the number was approximated at 30 individuals (Ruygt, pers. comm.). When discovered on 29 April 1992, the first flowers were opening, and flowering continued until at least 2 June 1992, at which time some fruits were mature. Some of the plants discovered may have been browsed, and so the stems may exceed 3 dm in height (Ruygt, pers. comm.). No subsequent observations have been made. This population is on private land, the Wild Horse Valley Ranch, which may be developed as a vineyard (Ruygt, pers. comm.).

Etymology.—This new subspecies was brought to my attention in 1992 by Jake Ruygt who discovered the plant while he was conducting botanical surveys as a subcontractor, and also as part of his ongoing research on the flora of Napa County, and its epithet has been chosen to reflect its known distribution.

The plants were growing in a sparsely vegetated area, described as Chamise and Mixed Chaparral (Ruygt, pers. comm.), with bare soil and abundant coarse gravel at a site where water puddles ephemerally following rain. The immediate associates were *Mimulus bolanderi* A.Gray, *Mimulus rattanii* A.Gray, *Navarretia heterodoxa* (Greene) Greene, and *Phacelia suaveolens* Greene. The typical local components in this plant community were *Adenostoma fasciculatum* Hook. & Arn., *Arctostaphylos canescens* Eastw., *A. glandulosa* Eastw., *A. stanfordiana* C.Parry, *Ceanothus purpureus* Jepson, *Pickeringia montana* Nutt., *Quercus wislizenii* var. *frutescens* Engelm., and *Rhamnus californica* Eschsch. The specimen matched best *Sidalcea hickmanii* subsp. *viridis* C. Hitchc. and this was my first tentative identification in September 1992, but it obviously differed from that in its deeply lobed leaves. Similar leaves are found on one other subspecies, *S. hickmanii* subsp. *anomala*, known only from the vicinity of Cuesta Pass in San Luis Obispo Co., but the new subspecies differs from that by its smaller bracts that are considerably shorter than the calyx, the fewer stems per plant, the essentially unbranched inflorescence, and its rather different habitat and range.

The single, and first, specimen of the new subspecies was collected west of St. Helena in 1942 by Milo S. Baker near the summit of Spring Mountain Road, apparently not far from the Sonoma County line, but precise location details were not recorded on the label. This general area lies within an elevation of 427–609 m (1400–2000 ft). Jake Ruygt brought this specimen to my attention as well and it is most certainly the same new subspecies.

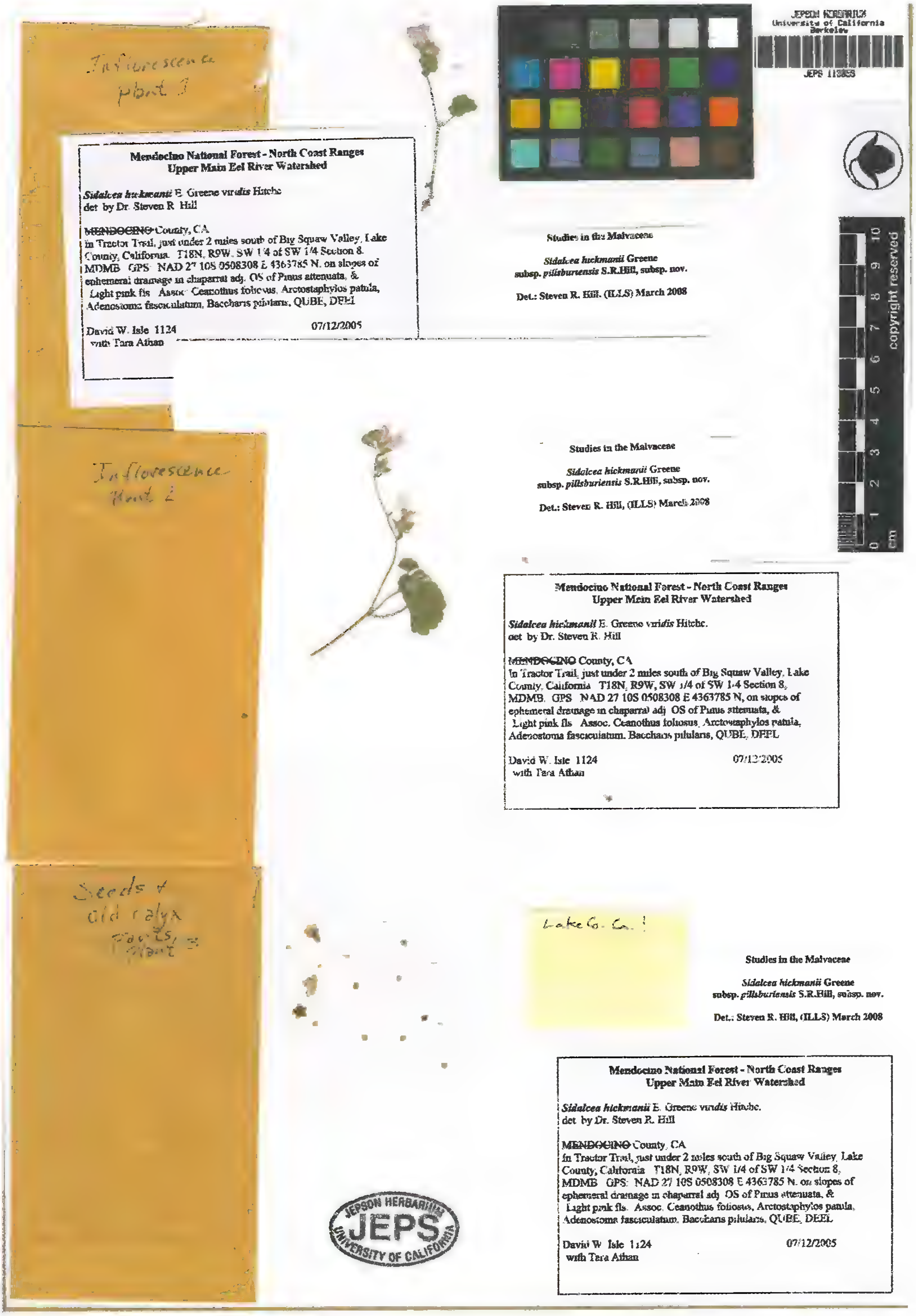
Paratypes. **U.S.A. California. Napa Co.:** divide between Santa Rosa and Napa Valley at point west of St. Helena town, near summit of Spring Mt. Road, 7 May 1942, *M.S. Baker 10193* (Milo S. Baker Collection 009782 at NCC!); E side of Mount George, ca. 4 mi E of Napa; elev. ca. 1380 ft; Chamise chaparral; lightly distributed in a sparsely vegetated area; rocky soils that puddle ephemerally following rain; associated with *Mimulus rattanii* and *Phacelia suaveolens*, 2 Jun 1992, *J. Ruygt 3019* (VT!); W of Leoma Lakes at base of Mt. George, elevation 1380 ft; Mt. George quad., T6N, R3W, NE/4 of NE/4 Sec. 29; chaparral, on rocky flat, roadway; Rhyolite, biennial or perennial?, 1.5–2 dm tall; corolla pink, 29 Apr 1992, *J. Ruygt 2911* (Ruygt pers. coll.!).

Sidalcea hickmanii Greene subsp. **pillsburiensis** S.R. Hill, subsp. nov. **(Figs. 2–4)**. Type: U.S.A. California. Lake Co.: [vicinity of Lake Pillsbury] in tractor trail just under 2 mi S of Big Squaw Valley, T18N, R9W, SW/4 of SW/4 Sect. 8, in Mt. Diablo Meridian and Base; GPS: NAD 27, 10S 0508308 E 4363785 N [UTM] [39.4375 N. Lat., -122.9375 W. Long.], on slopes of ephemeral drainage in chaparral adjacent overstory of *Pinus attenuate*; light pink flowers; associates: *Ceanothus foliosus*, *Arctostaphylos patula*, *Adenostoma fasciculatum*, *Baccharis pilularis*, *Quercus berberidifolia*, *Deschampsia elongata*, 12 Jul 2005, *D.W. Isle 1124 with Tara Athan* (holotype: JEPS 113056!).

Herba pumila perennis e caudicem erectum parvum. Caules aliquot erecti, ± (5–)10–30(–40) cm, viridulis, pubescentes pilis stellatis appressis densis moderate. Folia pauca (< 6 per caulem) pubescentia pilis stellatis caespitosis; folia mediana petiolis 6.5–20 mm longis; laminis latitudine plus quam longitudine, latiflabellatis, 8–15 mm longis × 12–22 mm latis, 7-nervatis palmatim, inlobatis, crenatis profundis aliquantum, ± 12-crenis; stipulis latilanceolatis, ± 3 mm longis × 1.3 mm latis, 1-nervatis, pilis similaribus atque in foliis. Inflorescentia floribus solitariis axillaribus aut brevis racemus, floribus dispersis prope basin 2-bracteatis, vel ad apicem bracteis solitariis, bracteis solitariis oblongis alveiformibus, brevioribus quam calycibus; bracteolis 3 oblongis persistentibus, 3 mm longis × 0.8–1.0 mm latis, brevioribus bis quam calyce, calycibus 4–5 mm longis × ± 6 mm latis, puberulis dense, pilis stellatis minutis omnibus; petalis roseis pallidis 8–10 mm longis × 4 mm latis. Fructus schizocarpium (4–)6–7-mericarpiis 1.5–2 mm altis × 2.0–2.3 mm longis × 1.0–1.3 mm latis, parietibus lateralibus laevibus, dorsis marginibusque 2–5-corrugatis-sinuatis, stria mediano in dorso; cuspide (mucrone) 0.

Dwarf perennial herb from a small erect caudex. Stems several, erect, ± (5–)10–30(–40) cm tall, greenish, pubescent with appressed moderately dense stellate hairs. Leaves few (< 6 per stem), pubescent with tufted stellate hairs; mid-stem leaves with petioles 6.5–20 mm long; blades wider than long, broadly fan-shaped, 8–15 mm long × 12–22 mm wide, palmately 7-veined, unlobed, rather deeply crenate, ± 12-crenations; stipules wide-lanceolate, ± 3 mm long × 1.3 mm wide, 1-nerved, with hairs similar to those on the leaves. Inflorescence with solitary axillary flowers or a short raceme, flowers scattered, those towards the base 2-bracted or with single bracts on those towards the apex, the single bracts oblong, cupped, much shorter than the calyx; bractlets 3, oblong, persistent, 3 mm long × 0.8–1.0 mm wide, half as long as the calyx; calyces 4–5 mm long × ± 6 mm wide, densely puberulent, with all hairs minute, stellate; petals pale pink (appearing nearly white in bright sunlight), 8–10 mm long × 4 mm wide. Fruit a schizocarp with (4–)6–7 mericarps 1.5–2 mm tall × 2.0–2.3 mm long × 1.0–1.3 mm thick, with smooth lateral walls, the back and margins with 2–5 wavy corrugations, single median line on back, cusp (mucro) 0.

I have seen only the single collection, but the plant has also been documented rather well with digital images. Habitat information and the images suggest that *S. hickmanii* subsp. *pillsburiensis* is a plant of open chaparral on non-serpentine rocky soils of the Franciscan Formation, at an elevation of 701 m (2300 ft). Only a single population has been documented and the total number of plants is unknown, though 24 were large enough to be counted and protected from browsing animals within wire mesh enclosures. Additional seedlings were found beneath *Ceanothus* shrubs in the Spring of 2006 (T. Athan, pers. comm.). When dis-


Inflorescence plant 3
Inflorescence plant 2
Seeds + old calyx parts, plant 3
Lake Co. Ca.!
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cm 0 1 2 3 4 5 6 7 8 9 10
Mendocino National Forest - North Coast Ranges
Upper Main Eel River Watershed
Sidalcea hickmanii E. Greene viridis Hitchc.
det by Dr. Steven R. Hill
~~MENDOCINO~~ County, CA
In Tractor Trail, just under 2 miles south of Big Squaw Valley, Lake County, California. T18N, R9W, SW 1/4 of SW 1/4 Section 8, MDMB. GPS: NAD 27 10S 0508308 E 4363785 N, on slopes of ephemeral drainage in chaparral adj. OS of Pinus attenuata, & Light pink fls. Assoc. Ceanothus foliosus, Arctostaphylos patula, Adenostoma fasciculatum, Baccharis pilularis, QUBE, DEEL
David W. Isle 1124
with Tara Athan
07/12/2005
Studies in the Malvaceae
Sidalcea hickmanii Greene
subsp. pillsburiensis S.R.Hill, subsp. nov.
Det.: Steven R. Hill, (ILLS) March 2008
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Fig. 2. Holotype of *Sidalcea hickmanii* Greene subsp. *pillsburiensis* S.R. Hill, subsp. nov., *D.W. Isle 1124* with *Tara Athan*, 12 Jul 2005 (JEPS 113056).

covered on 7 July 2003, the plants were in flower. On 12 July 2005 plants were still in flower, and a few ripe fruits were also found, and it continued to flower until at least 27 August 2005. The site was visited several additional times in late 2005 and early 2006, but no information is available on more recent visits. This single population is on Mendocino National Forest land (under federal ownership).

Etymology.—The subspecies epithet has been chosen to reflect its known distribution close to the margin of, and upslope from, Lake Pillsbury.

This new subspecies was brought to my attention by National Forest botanist David Isle who, along with fellow botanist David Toren, discovered the plant during surveys of a tractor fire line near Lake Pillsbury in 2003 ("Tractor Line, Big Squaw Valley to 2001 Pillsbury Fire"). The plants were growing in a sparsely vegetated area with bare soil and gravel on both slopes of an ephemeral drainage. In this habitat the water flow would be limited to winter rain events, but no areas of pools were evident. The plant association (D. Isle, pers. comm.) best fits the description of scrub oak—chamise chaparral, with dominants that included *Quercus berberidifolia* Liebm. and *Adenostoma fasciculatum*, as well as the associates *Arctostaphylos patula* Greene, *Arnica* sp., *Baccharis pilularis* DC., *Camissonia hirtella* (Greene) Raven, *Ceanothus foliosus* C.Parry, *Cryptantha* sp., *Deschampsia elongata* (Hook.) Benth., *Epilobium minutum* Lindl. ex Lehm., *Galium nuttallii* A.Gray, *Lotus denticulatus* (E.Drew) Greene, *Madia minima* (A.Gray) Keck, *Mimulus moschatus* Doug. ex Lindl., *Nemacladus capillaris* Greene, *Pedicularis densiflora* Benth. ex Hook., *Penstemon heterophyllus* Lindl., *Polygala californica* Nutt., and *Potentilla* cf. *glandulosa* Lindl. It adjoined a knobcone pine / chamise association, dominated by *Pinus attenuata* Lemmon and *Adenostoma fasciculatum*. The images and sample sent to me in 2005 matched best *Sidalcea hickmanii* subsp. *viridis* C.Hitchc. and this was my first tentative identification, but it appeared to differ from that in its dwarfed habit, open inflorescence, and shorter bracts and bracteoles. The crenate, truncate leaves can be found on that subspecies and on the typical subspecies as well, but these were remarkably small on this new subspecies in comparison. Another difference noted was in the pubescence of the upper stem; in this new subspecies the hairs are stellate but appressed, whereas on subsp. *viridis* the hairs are distinctly tufted. The flowers appeared closer to bright white than pink when fresh (D.Isle, pers. comm.).

Sidalcea hickmanii subsp. *pillsburiensis* has been collected twice. The first collection was made by David Toren and David Isle on 7 July 2003, *D. Toren 9318*. This was mailed to me on November 1, 2005, but, sadly, I have no record that this specimen ever arrived and there was no duplicate. The second collection was made by David Isle, with Tara Athan, on 12 July 2005, and this specimen was sent separately and arrived safely. This specimen consisted of 2 stem fragments and several mature fruits, from 3 separate plants at the single site, and these have been deposited in the Jepson Herbarium (JEPS) to serve as the holotype. Photographs of the plants were made on August 10 and 27, 2005, by David Isle (Fig. 4) and members of the Sanhedrin Chapter of the California Native Plant Society, whose volunteer members also enclosed 24 of the previously located plants within wire-mesh cages to protect them from animal (deer) foraging—a problem that had already been reported at the site. All of the living stems were quite short and very possibly animal-browsed, but the associated dried stems from the previous season were 30–40 cm tall and probably not browsed (D. Isle, pers. comm.). The chapter volunteers have shown an interest in monitoring these plants and to look for any additional populations. The population appears to be vulnerable to heavy deer foraging, and individuals within the tractor fire line may be damaged by its maintenance.

With the finding of these two new subspecies, there are now six named subspecies of *Sidalcea hickmanii* in California, all of whose populations are small, isolated, and vulnerable. In order to better facilitate their identification, the following key to these subspecies has been provided below.

It should be noted here that flower size in *Sidalcea* often varies by its sexuality—and the genus has often been characterized by the presence of bisexual flowers as well as pistillate flowers in various combinations in the species and on individuals. It is easily observed that pistillate flowers (with aborted anthers) are

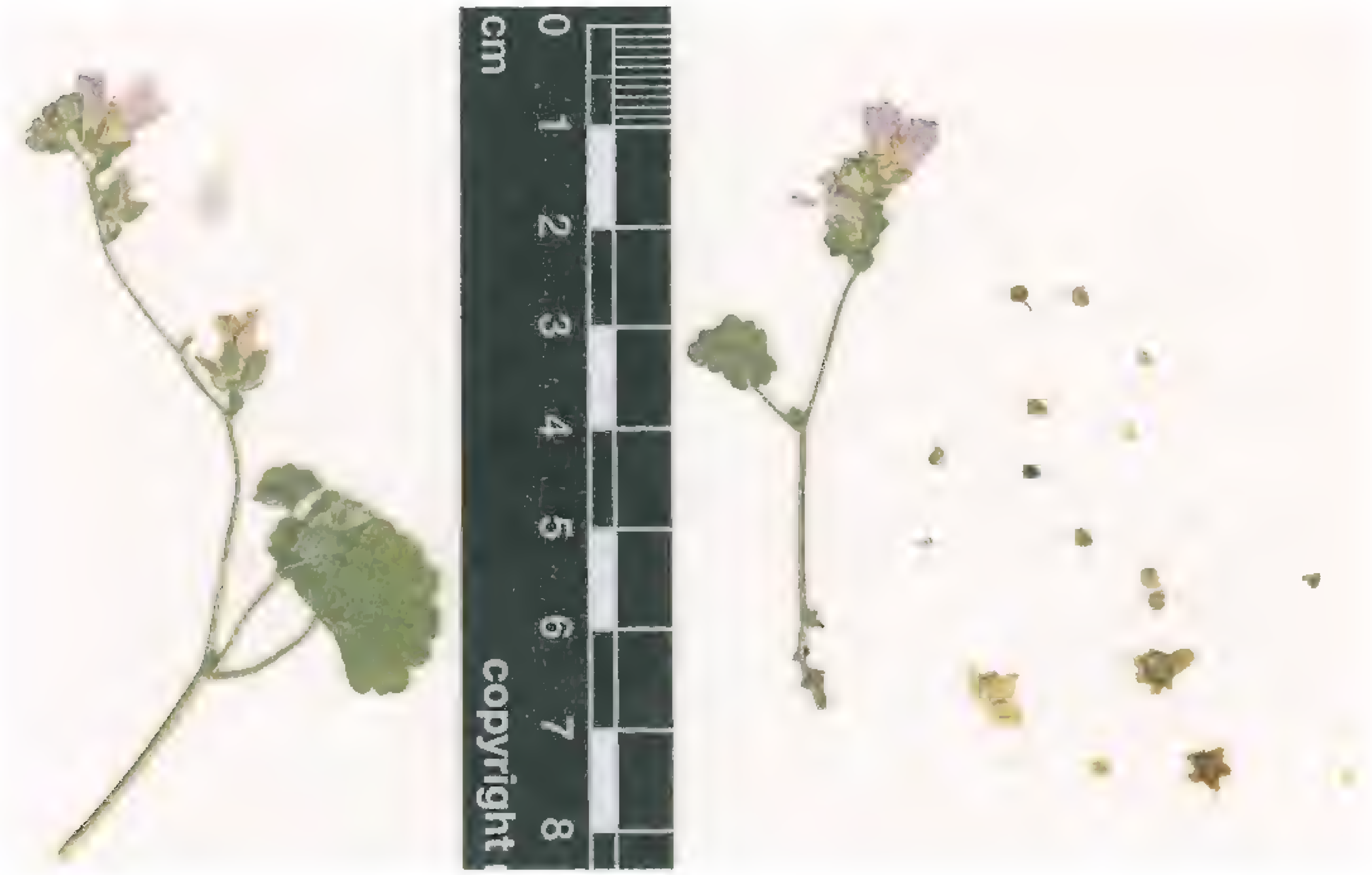

Fig. 3. Enlargement of the plant material from the holotype sheet shown in Fig. 2 of *Sidalcea hickmanii* Greene subsp. *pillsburiensis* S.R. Hill (JEPS113056).

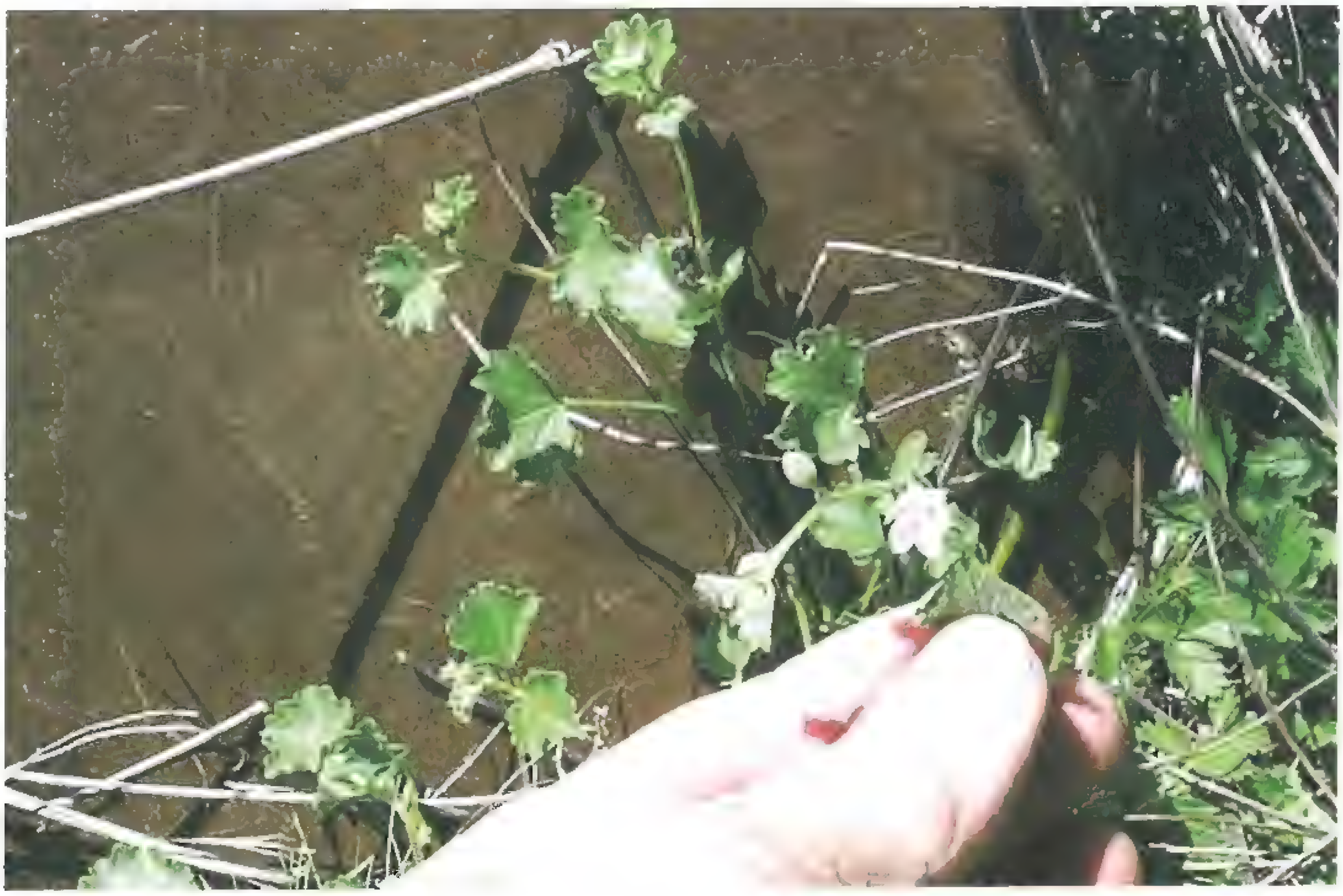

Fig. 4. *Sidalcea hickmanii* Greene subsp. *pillsburiensis* S.R. Hill, subsp. nov. Photograph by D.W. Isle, 10 Aug 2005.

generally much smaller than bisexual flowers within a species, having petals even half the length of those in bisexual flowers. The two newly described subspecies of *S. hickmanii* are represented by very few collections, and so the sample size is small. In all of these collections the flowers are bisexual and, therefore, no size variation based on sexuality has been seen. However, I have been unable to find any such size variation in the flowers of any of the subspecies of *S. hickmanii* to date (nor am I aware of any mentioned in the literature for this species). I am not yet willing to generalize that all *S. hickmanii* flowers are bisexual and show no variation in size correlated with their sexuality, but I have, as yet, not observed such variation in the species.

The following key uses the acronyms for bioregional distribution as found in the Jepson Manual (Hickman 1993).

KEY TO CALIFORNIA SUBSPECIES OF *SIDALCEA HICKMANII*

1. Most leaves deeply lobed ± to base.
   2. Bracts ≥ (8–)10–12 mm, ± = calyx; SCoRO: c San Luis Obispo Co. subsp. **anomala**
   2. Bracts 5.5–7 mm, < calyx; NCoRI: Napa Co. subsp. **napensis**, subsp. nov.
1. Leaves not lobed, or deeply crenate to shallowly lobed much less than 1/4 length.
   3. Bracts lanceolate, generally 6–10 mm × 2.5–4 mm wide, ± < calyx; bractlets ± = or < calyx; leaves above unlobed or very shallowly lobed < 1/4 length; SCoRO, w WTR: Santa Barbara Co.; SnBr subsp. **parishii**
   3. Bracts linear, linear-lanceolate, or oblong, 2–7 mm × 0.5–2 mm wide, << calyx; bractlets < calyx; leaves above always unlobed.
      4. Plant generally 4–8 dm, grayish-canescent; calyx densely stellate-puberulent, marginal hairs much longer; bractlets 2–7 mm long; largest leaves deeply cordate, closely crenate, often > 30 mm wide; inflorescence ± dense; SCoRO subsp. **hickmanii**
      4. Plant generally < 4 dm, greenish, less hairy; calyx stellate-puberulent but generally not densely so, hairs uniform in length; bractlets 2–5 mm long; larger leaves truncate to wide-cuneate, coarsely crenate, generally < 25 mm wide, wider in robust plants; inflorescence generally more open.
         5. Bracts of upper flowers generally 2, flat or cupped; leaf blades 1–2.5 cm × 2.5–4 cm wide; stem above with tufted hairs generally 0.5–1.2 mm long; stems generally > 30 cm long, flowers > 10, inflorescence ± spicate in age; calyx 4–7 mm long; n CCo subsp. **viridis**
         5. Bracts of upper flowers 1, cupped; leaf blades 0.6–1.2 cm long × 0.7–2.1 cm wide; stem above with appressed hairs generally 0.2–0.5 mm; stems generally < 30 cm long, flowers < 10, inflorescence not spicate; calyx 4–5.5 mm long, NCoRH: n Lake Co. subsp. **pillsburiensis**, subsp. nov.

ACKNOWLEDGMENTS

I thank David W. Isle, Jake Ruygt, David Toren, and Tara Athan for not only bringing these plants to my attention, but for their astute observations, plant and site images, and stimulating correspondence concerning these taxa in recent years. I also thank Linda M. Prince, of Rancho Santa Ana, for generously sharing images of the other subspecies as well as data from her molecular studies within this group. I would especially like to thank Bruce G. Baldwin and the Lawrence R. Heckard Endowment Fund of the Jepson Herbarium for the funding to visit the UC / JEPS and CAS herbaria to study herbarium specimens in support of my work on several Malvaceae genera for the upcoming revision of the *Jepson Manual: Higher Plants of California*. The UC / JEPS and CAS staff were especially hospitable during my visit and very generous with their time. Special thanks go to Rich Whitkus of Sonoma State University for the loan of the important *Sidalcea* specimens collected by Baker from the herbarium (NCC), and to Richard Halse for his generous sharing of expertise and specimens of the genus. A continuing contract with the Illinois Department of Transportation is gratefully acknowledged for financial support towards research and publication of these studies.

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BOOK REVIEW

M.G. Vakhrameeva, I.V. Tatarenko, T.I. Varlygina, G.K. Torosyan, and M.N. Zagulski. 2008. **Orchids of Russia and Adjacent Countries (within the borders of the former USSR).** (ISBN 978-3-906166-61-2, hbk.). Koeltz Scientific Books, Koenigstein, Germany. (**Orders:** www.koeltz.com or www.orchidbooks.com). $212.00, 690 pp., color distribution maps, photographs, and watercolor plates.

Orchids of Russia is a massive work that covers much of Eastern Europe and northern Asia and treats nearly all of the temperate terrestrial orchids to be found in that region. It is the first complete, modern scientific treatment of the orchid flora of the former USSR. The authors studied orchids for more than 30 years, in different climatic zones—polar regions of the Cola Peninsula, temperate zones in Central Russia, Central Ukraine, Baltic Sea coast territories, Mediterranean regions in the Crimea and Caucasus, continental climate in Siberia and Central Asia, and monsoonic climate in the Far East of Russia. The first several chapters consist of detailed essays by the various authors and are entitled History and Contemporary Tendencies in Orchid Studies, Systematic Review, Species Distribution, Ecology and Phytocoenology, Morphology, Ontogenesis, Rhythm of Seasonal Development and Reproduction, Mycorrhiza, and Species Protection. The bulk of the book is devoted to the species descriptions and they are very complete and easy to understand. Throughout the book extensive use of references is made, resulting in more than 70 pages in the bibliography. A brief glossary contains not only the technical terms but several Anglicized Russian terms that help in understanding the text. I now know that a *Zapovendik* is a highly protected area under government control that prohibits economic activities or a 'nature preserve'.

A work such as this is written over many years and, judging from the references, contains data through 2004. Several genera and species also found in North America are included, many of these quite rare and found especially in Alaska. It is helpful to have more information on these species. They include *Calypso bulbosa, Cypripedium guttatum, C. yatabeanum, Dactylorhiza aristata, Goodyera repens, Liparis loeselii, Listera cordata, Lysiella oligantha (Platanthera obtusata* subsp. *oligantha), Malaxis monophyllos, Platanthera convallariifolia, P. dilatata, P. chorisiana*, and *P. tipuloides*. Several of our non-native North American species are native in this region and include treatments of *Epipactis atrorubens, E. helleborine, E. palustris, Listera ovata*, and *Zeuxine strateumatica*. One of the most interesting treatments is in the use of the genera *Lysiella* as mentioned above and *Tulotis*. The latter would include the eastern North American *Platanthera flava*.

Many scientific works originally written in a language other than English often suffer greatly in translation, but no so with this book. The English is excellent and the proofreading exceptional. Over 200 color photos of the species are complemented by numerous excellent watercolors and supplemented by 18 line drawings and 93 distribution maps. It is here that the book has its only significant fault. No key map is provided for either the geography or showing the several ecological regions so often mentioned in the book. For those not intimately familiar with the many countries of the former USSR and their locations, this can be very confusing. If only one page were devoted to a simple outline map showing the borders of these countries it would make the book much more usable. Fortunately such a map is easily accessible on the internet, and I found an excellent one at www.theodora.com. The names of a few of the countries are slightly different from those used in the book, but easily understood. The map can be printed out and inserted within the book for reference. I highly recommend *Orchids of Russia* for all orchid professionals and enthusiasts with an interest in the native orchids of this region.—*Paul Martin Brown, 10896 SW 90th Terrace, Ocala, Florida 34481, U.S.A., naorchid@aol.com.*

IPOMOEA TEHUANTEPECENSIS (CONVOLVULACEAE): A NEW SPECIES FROM THE ISTHMUS OF TEHUANTEPEC, MEXICO

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ABSTRACT

A new and narrowly endemic species from the Tehuantepec District of Oaxaca, **Ipomoea tehuantepecensis** L. Torres Colín, R. Torres Colín, M.P. Ramírez & J.A. McDonald, is described and illustrated. The new species belongs to a primitive assemblage of hairy-seeded lianas (*I.* subg. *Eriospermum* Verdc.) that exhibit specialized red and hypocrateriform corollas with exserted reproductive structures (*Ipomoea* ser. *Mirandinae* D.F. Austin). *Ipomoea tehuantepecensis* shares numerous morphological traits with *I. concolora* (Matuda) D. Austin and *I. conzattii* Greenm. in arid regions of southern Mexico but differs by glabrous laminas with obtuse to subcordate leaf bases, pleiocasial cymes, glabrous pedicels less than 6 mm long, glabrous sepals from 4–4.5 mm long and 2–3 mm wide, and glabrous corollas up to 3.0 cm long. In contrast, *I. conzattii* and *I. concolora* present pubescent laminas with cordate or truncate-obtuse leaf bases, monochasial cymes, pubescent pedicels from 7–15 mm long, sericeous sepals from 5–8 mm long, and pilose or sericeous corollas from 3.0–4.5 cm long.

RESUMEN

Se describe e ilustra a **Ipomoea tehuantepecensis** L. Torres-Colín, R. Torres-Colín, M.P. Ramírez & J.A. McDonald, una nueva especie endémica del Distrito de Tehuantepec, Oaxaca, México. La nueva especie se ubica en un grupo de lianas con semillas comosas (*I.* subg. *Eriospermum* Verdc.), las cuales presentan corolas rojas e hipocrateriformes y estructuras reproductivas exertas (*Ipomoea* ser. *mirandinae* D.F. Austin). *Ipomoea tehuantepecensis* está relacionada morfológicamente con *Ipomoea concolora* (Matuda) D. Austin e *I. conzattii* Greenm., de las cuales se distingue por sus hojas glabras con bases obtusas a subcordadas, inflorescencias en pleiocasios, pedicelos glabros de menos de 6 mm de largo, sépalos glabros, 4–4.5 mm largo y 2–3 mm ancho y corollas glabras hasta 3 cm largo. *Ipomoea conzattii* y *I. concolora* presentan hojas pubescentes con bases cordadas o truncado-obtusas, monocasios, pedicelos tomentosos o seríceos de 7–15 mm largo, sépalos seríceos, 5–8 mm largo, y corolas pilosas o seríceas de 3.0–4.5 cm largo.

Recent floristic investigations in the Tehuantepec District of Oaxaca, Mexico, have uncovered ten species of *Ipomoea* (Torres-Colín 1989; Torres et al. 1997), one of which is new to science. The new species belongs to *Ipomoea* subg. *Eriospermum* Verdc. on the basis of lignescent stems and comose seeds and is accommodated comfortably within *Ipomoea* ser. *Mirandinae* D.F. Austin s. str. (Austin 1977, 1979; = I. 'microsticta complex' sensu McPherson 1979 or *I.* ser. *Eriospermum* s. lat., Austin & Huáman 1996) on account of its deciduous leaves and relatively small (4.0–4.5 mm long), subequal sepals. These and a combination of ornithophilous floral features, including red, hypocrateriform corollas, and exserted reproductive structures suggest close relations with *Ipomoea concolora* (Matuda) D.F. Austin and *I. conzattii* Greenm., distinctions between which are presented herewith.

Ipomoea tehuantepecensis L. Torres-Colín, R. Torres-Colín, M.P. Ramírez & J.A. McDonald, sp. nov. (**Figs. 1A–G**). Type: MEXICO. Oaxaca: Distrito Tehuantepec, Mpio. Tehuantepec, road to Arroyo de Las Minas, to the W of Rancho Limón, 24 km to the W Tehuantepec, entering Hierba Santa on road to Buenos Aires (16°18'N, 95°27'W), 600 m, 23 Jan 1988, *Rafael Torres C. 11255 & Cipriano Martínez R.* (holotype: MEXU; isotypes: ENCB, MEXU, MO, OAX, PAUH).

Species haec ab *I. conzattii* Greenm. et *I. concolora* (Matuda) D. Austin differt laminis glabris basibus laminarum obtusis vel subcordatis pleiocymis pedunculis glabris pedicellis glabris maxima 6 mm longis sepalis glabris 4.0–4.5 mm longis 2–3 mm latis corollas glabris maxima 3 cm longis.

Twining lianas; Stems cylindrical, to 5 mm in diameter, bark yellow-brown, striate, glabrous, rarely squamose, lenticels abundant. Leaves deciduous before anthesis; blades ovate to broadly ovate, (3.8–)5.5–11.0

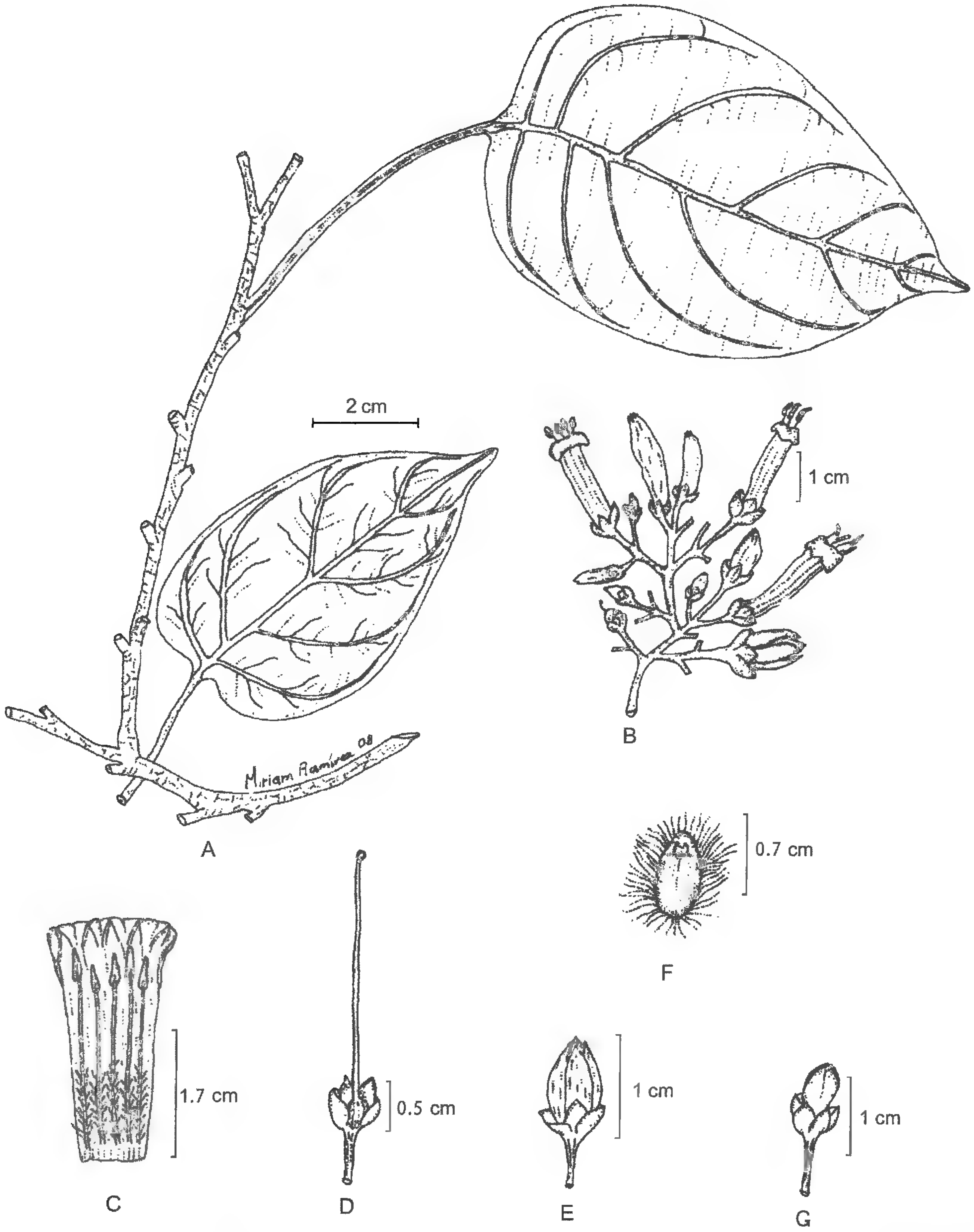

Fig. 1. ***Ipomoea tehuantepecensis*. A. Vegetative features prior to anthesis, including stems and leaves (based on *Campos 4116* and *3831*). B. Compound pleiocasium with flower and fruit. C. Androecium of dissected corolla. D. gynoecium. E. Mature capsule (based on *Rafael Torres 11255*). F. Ventral surface of mature seed. G. Persistent septum of dehisced capsule (based on *Rafael Torres 4892*).**

cm long, (2.5–)3.5–8.5 cm wide, upper surface dark green, lower surface light green, chartaceous, glabrous on both surfaces, apex acute, base obtuse or rarely subcordate, margin entire; petiole basally canaliculate, distally terete, striate, (2.0–)3.0–8.7 cm long, 1–2 mm wide, glabrous. Inflorescence a pleiocasium 4.0–6.0 cm long, flowers 15–45, primary peduncle 1–3 mm long, glabrous, secondary peduncles 4–6 mm long, bracteoles deciduous; pedicels 4–6 mm long, erect, glabrous, sparingly dilated at the apex, striate; sepals imbricate, reddish, ovate to broadly ovate, 4.0–4.5 mm long, 2–3 mm wide, chartaceous, glabrous, the margins entire, apex obtuse, rarely acute, mucronate; corolla hypocrateriform, red, 2.5–3.0 cm long, tube 2.5–2.8 cm long, 5–6 mm in diameter, limb irregularly 5-lobate; segments 3–6 mm long; stamens 5, subequal, exserted, filaments basally pubescent, anthers yellow; style exserted, glabrous, ca. 3 cm long, stigma capitate. Fruit a capsule, ellipsoid, 9–13 mm long, 6–7 mm wide, 4-valvate, brown, chartaceous, dehiscent, glabrous; seeds 4, brown, ellipsoid, three angled, 7 mm long, ca. 4.6 mm wide, the lateral margins comose, hairs cream, ca. 7 mm long.

Habitat.—*Ipomoea tehuantepecensis* thrives in short tropical deciduous forest on dry gradients between 200–750 meters. The vines prefer steep slopes with thin soil mantles and often grow in association with *Bursera schlechtendalii* Engl., *Gossypium aridum* (Rose & Standl.) Skovst., and *Juliania adstringens* Schltdl.

Distribution.—As presently known, *I. tehuantepecensis* is a narrow endemic of Oaxaca, Mexico, known only from the District of Tehuantepec in the Municipalities of Santiago Laollaga and Santo Domingo Tehuantepec (Fig. 2).

Phenology.—*Ipomoea tehuantepecensis* flowers and fruits following the rainy season, from November to March.

Etymology.—The species epithet refers to the Isthmus of Tehuantepec, in which the new taxon is apparently restricted.

Specimens examined: **MÉXICO. Oaxaca:** Distrito de Tehuantepec, Municipio Santiago Laollaga, recorrido a las faldas del Cerro Indio Dormido, al S de Laollaga, *Álvaro Campos V. 4116* (MEXU, PAUH). Municipio Santo Domingo Tehuantepec, Cerro Guiengola, 11 km al NO de Tehuantepec, *Álvaro Campos V. 3831 y Cipriano Martínez R.*(MEXU, PAUH); *Álvaro Campos V. 4242* (MEXU, PAUH); Cerro Guiengola, 11 km al NE de Tehuantepec, *Abisaí García M. 2802, L. Torres C. y L. Cortés A.* (MEXU); subida a las ruinas del Cerro Guiengola, *Leticia Torres C. 243, R. Torres C. y C. Martínez R.* (MEXU); Cerro Guiengola, ladera S entrando por Paso Alicia, *Leticia Torres C. 306, R. Torres C. y C. Martínez R.* (MEXU, PAUH); ruinas del Cerro Guiengola, al N de Tehuantepec, *Leticia Torres C. 336, R. Torres C., Pedro Tenorio L. y Cipriano Martínez R.* (MEXU, PAUH); ladera S del Cerro Guiengola, por la fábrica de cal, *Leticia Torres C. 774, R. Torres C., L. Cortés A. y Cipriano Martínez R.* (MEXU, PAUH); Cerro Guiengola at the ruins, *P.J. Stafford 8 y R.J. Hampshire* (MEXU); Cerro Guiengola, al N de Tehuantepec, *Rafael Torres C.4892 y Cipriano Martínez R.*(MEXU, PAUH).

DISCUSSION

Ipomoea tehuantepecencis and its close relatives, *I. concolora* and *I.conzattii*, belong to an assemblage of deciduous lianas that extends from southern Mexico to northern South America, with a secondary center of diversity in the Caribbean (Austin 1977). *Ipomoea tehuantepecencis* is distinguished by glabrous laminas with an obtuse or subcordate leaf base, while the blades of *I. conzattii* are strigose and elliptical with obtuse bases. Laminas of *I. concolora* are tomentose on the undersurface and basally cordate. Whereas *I. tehuantepecensis* produces compound cymes with secondary peduncles from 4–6 mm long, *I. conzattii* and *I. concolora* exhibit simple cymes with secondary peduncles that range from 2–4(–5) mm long. Glabrous pedicels of *I. tehuantepecencis* are relatively short, ranging from 4–6 mm long, contrasting with those of *I. conzattii* and *I. concolora*, which are pubescent and 10–15 mm or 7–12 mm long (respectively).

Like many other *Ipomoea* species, *I. tehuantepecencis* is readily diagnosed by distinctive sepals, these being reddish, glabrous, and relatively small (4–4.5 mm long, 2.3 mm wide). In contrast, sepals of *I. conzattii* are greenish, sericeous, 5–7 mm long, and 4–6 mm wide, and those of *I. concolora* are reddish, sericeous, 7–8 mm long, and 3.5–4 mm wide. The brightly colored, glabrous corollas of *I. tehuantepecensis* are 2.5–3.0 cm long, the tube less than 2.8 mm in diameter at base and 5.0–6.0 mm from the middle to the throat, while corollas of *I. conzattii* and *I. concolora* are pilose and sericeous (respectively), measuring from 3.0–4.5 cm long. These and other less discrete distinctions are summarized in Table 1.

ACKNOWLEDGMENTS

The authors thank Cipirano Martínez Ramírez and Alvaro Campos Villanueva for collecting ample plant materials during botanical explorations of the Isthmus of Tehuantepec, Oaxaca.

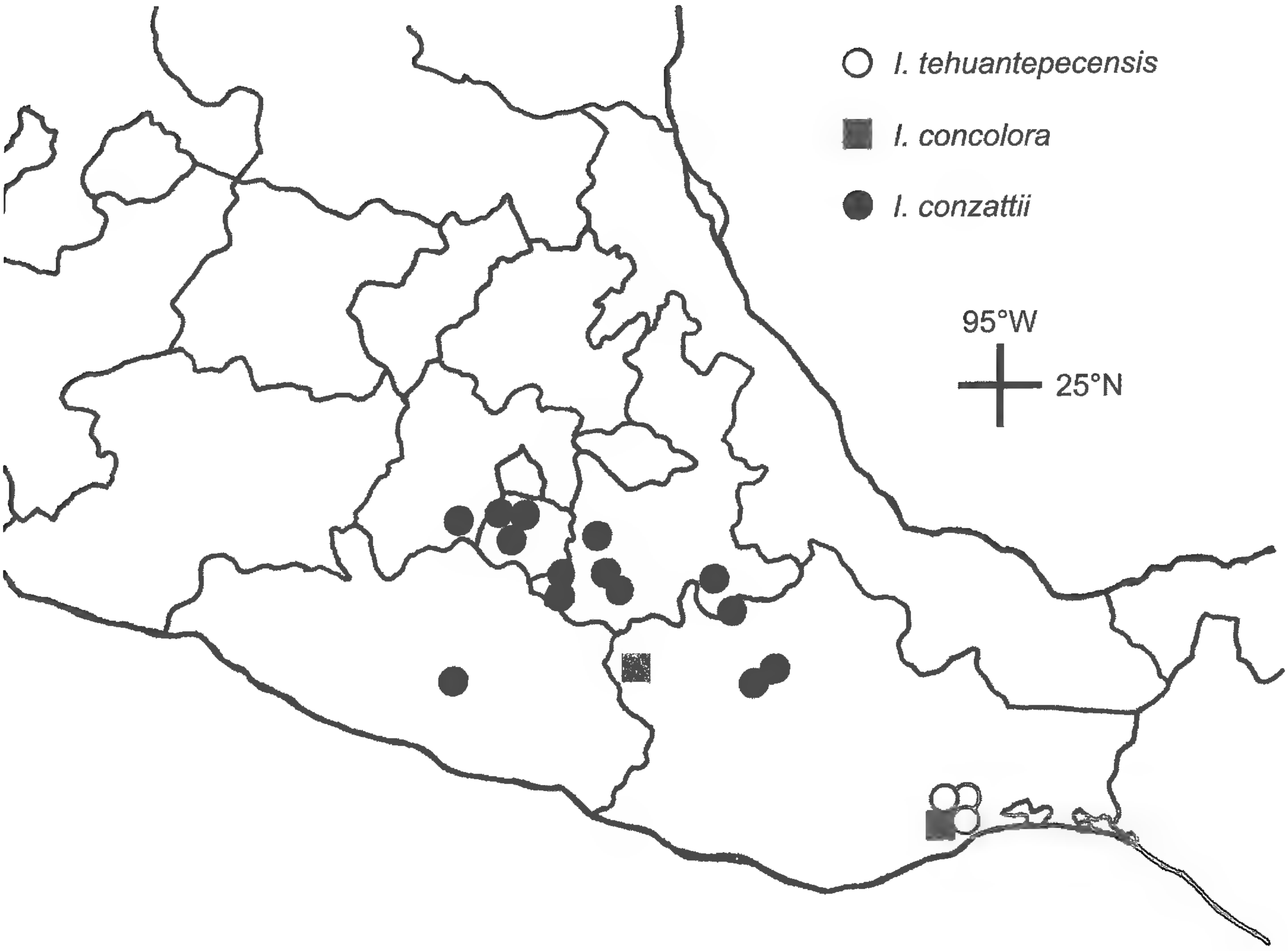

Fig. 2. Known distributions of *I. tehuantepecensis* (open circles), *I. concolora* (closed squares) and *I. conzattii* (closed circles) in arid regions of southern Mexico. Note that *I. tehuantepecencis* and *I. concolora* are partially sympatric.

Table 1. Comparative morphology of *Ipomoea concolora, I. conzattii,* and *I. tehuantepecensis*

	Ipomoea conzattii	Ipomoea concolora	Ipomoea tehuantepecensis
Blades	Elliptic, base truncate to obtuse, both surfaces strigose	Broadly ovate, base cordate, upper surface glabrous, lower surface tomentose	Ovate to broadly ovate, base obtuse to subcordate, glabrous on both surfaces
Inflorescence	Monochasium, secondary peduncles 3–5 mm long, tomentose	Monochasium, secondary peduncles 2–4 mm long, sericeous	Pleiocasium, secondary peduncles 4–6 mm long, glabrous
Pedicels	10–15 mm long, tomentose	7–12 mm long, sericeous	4–6 mm long, glabrous
Sepals	5.0–7.0 mm long, 4–6 mm wide, greenish, sericeous, apex acute to roundish, not mucronate	7.0–8.0 mm long, 3.5–4.0 mm wide,reddish, sericeous, apex acute, not mucronate	4.0–4.5 mm long, 2–3 mm wide, reddish, glabrous, apex obtuse, mucronate
Corolla	3.0–4.5 cm long, scarcely pilose, tube 2.5–3.5 cm long, 0.5–0.7 cm wide, limb segments 1.0–1.5 cm long	3.3–4.0 cm long, sericeous, tube 3.0–3.6 cm long, 0.5–0.6 cm wide, limb segments 0.3–0.4 cm long	2.5–3.0 cm long, glabrous, tube 2.5–2.8 cm long, 0.5–0.6 cm wide, limb segments 0.3–0.6 cm long

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BOOK REVIEW

WILHELM BARTHLOTT, STEFAN POREMBSKI, RÜDIGER SEINE, AND INGE THEISEN. 2007. **The Curious World of Carnivorous Plants, a Comprehensive Guide to their Biology and Cultivation.** (ISBN 978-0881927924, hbk.). Timber Press Inc., 133 S.W. Second Avenue, Suite 450, Portland, Oregon 97204-3527, U.S.A. (**Orders:** www.timberpress.com, mail@timberpress.com, 800-327-5680, 503-227-3070 fax). $39.95, 224 pp., 158 color and black/white illustrations, 2 maps, 7 1/2" × 10 1/4".

Contents:

1. Preface
2. The Flowers of Evil: An Introduction
3. Habitats
4. Biogeography and Diversity
5. Attracting and Trapping Mechanisms
6. Digestion of Prey and Nutrient Uptake
7. Prey
8. Guests at the Carnivores' Table: The Commensals
9. Noncarnivorous Animal-Trapping Plants
10. The Evolution of Carnivory
11. Growing Carnivorous Plants
12. Nature Conservation
13. Bromeliaceae: Pineapple Family (Bromeliads)
14. Byblidaceae: Rainbow Plant Family
15. Cephalotaceae: Australian Pitcher Plant Family
16. Dioncophyllaceae: Hookleaf Family
17. Droseraceae: Sundew Family
18. Drosophyllaceae: Portuguese Sundew Family
19. Lentibulariaceae: Bladderwort Family
20. Nepenthaceae: Asian Pitcher Plant Family
21. Roridulaceae: Bug Plant Family
22. Sarraceniaceae: American Pitcher Plant Family
23. Animal-Trapping Liverworts
24. Animal-Trapping Fungi
25. The Carnivorous Plants of the World: A Comprehensive Listing from A to Z
26. Glossary
27. Bibliography
28. Index
29. Carnivorous Plant Societies and Sources

Sundews and waterwheels and corkscrews! Oh, my! These innocently named plants harbor deep dark secrets, described as "against the order of nature as willed by God" by Carl Linnaeus in late 1700s. Set apart from "normal" plants, these devious beauties use murderous means to obtain their nutrients, utilizing specialized structures to attract, trap, and subsequently digest otherwise unknowing members of the animal kingdom. The gory secrets behind this carnivorous comportment comprise the topic of this book, initially released by the authors in the German language in 2004, then re-released in an updated and revised English-language edition in 2007.

In chapters 2-4, the authors identify the open, low-nutrient, and moist sites that characterize carnivorous plant habitat and their distribution of greatest diversity between 20°N and 40°S latitude. Chapters 5-10 discuss the generalized process by which these plants obtain their nutrients, including attraction strategies (such as optical, tactile, and olfactory mechanisms), trapping mechanisms (adhesive, snapping, snaring, or suction), digestion, and types of prey. Belief in the completely dark nature of these plants is dispelled in chapters 8 and 9 when the notion of carnivorous plants as commensals is introduced: plants providing habitats for animals without using them as a nutrient source. Carnivorous plants are not unique as facilitators of animal death, and the animal-killing capabilities of "normal" plants (however unintentional the outcome of their herbivory defense tactics) are briefly discussed. Chapters 11 and 12 comprise the key sections for any carnivorous-plant grower's reference, providing advice on a range of topics, from what to look for when picking out plants, to the basic requirements to grow and maintain them, to the species best suited to beginners.

Lastly, chapters 13 through 24 take the reader deeper into the major groups of carnivorous plants, discussing monocot and dicot flowering plant families (e.g. Bromeliaceae and Lentibulariaceae, respectively) and those groups of plants we don't commonly associate with carnivory, such as the liverworts and fungi (the former whose candidacy as a carnivore is contested, as their prey are protozoans). These chapters include preliminary discussions of each family, what it is related to, and what portion of its members are carnivores. Also included are sections for each genus where distribution and habitat, morphological features, trapping mechanism, digestion and prey, selected species, and cultivation are mentioned. Varying degrees of carnivory are explored, from life-long obligate carnivores (*Byblis gigantea*: Byblidaceae) to others that only employ carnivory during part of their life cycle (*Drosera caduca*: Droseraceae) or during certain seasons (*Pinguicula*: Lentibulariaceae). Carnivory across habit is noted in epiphytes (Bromeliaceae), terrestrial plants (Sarraceniaceae), lianas that straddle between the two (*Triphyophyllum*: Dioncophyllaceae), and aquatic plants (some Lentibulariaceae). Interesting histories are related, such as the fact that it was Schnepf's studies of the mucilaginous glands of the genus *Drosophyllum* which led him to elucidate the function of the Golgi apparatus, which had been discovered 62 years earlier by Camillo Golgi.

This book is written in a popular science style, backed with scientific references and botanical knowledge; it is an incredible assemblage of facts, from the ecology and physiology of carnivorous plants, to the history of their names and uses, to the practical and hands-on act of welcoming these plants into one's own horticultural collection. This book will enchant any reader and is highly recommended for anybody with any interest whatsoever in cultivation of strange and unusual plants.—*Tiana F. Franklin, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

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ILLICIUM GUAJAIBONENSE, ELEVATED TO SPECIES RANK AND COMPARED WITH THE SUBSPECIES OF *ILLICIUM CUBENSE* (ILLICIACEAE)

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ABSTRACT

Illicium cubense subsp. *guajaibonense* has been re-collected on the slopes of Pan de Guajaibón, Pinar del Rio, Cuba. The smooth epidermal cells of the petioles and stems of these plants and their red flowers with usually obovate to lingulate inner tepals, which are recurved-spreading, support the recognition of this entity as a distinct species, **Illicium guajaibonense,** and a new combination is provided. The newly recognized species is also provided with an expanded description and compared to the geographically isolated populations of *I. cubense*.

RESUMEN

Illicium *cubense* subsp. *guajaibonense* ha sido re-encontrada en las vertientes de Pan de Guajaibón, Pinar del Río, Cuba. Las células epidérmicas lisas de los pecíolos y de los tallos de estas plantas, junto a sus flores rojas con tépalos internos generalmente obovados a lingulados, los cuales son recurvados-extendidos, apoyan el reconocimiento de esta entidad como una especie distinta, **Illicium guajaibonense,** por lo que se propone una nueva combinación. Se provee una descripción ampliada para la especie aquí reconocida y se compara con las poblaciones geográficamente aisladas de *I. cubense*.

Key Words: *Illicium*, Illiciaceae, Cuba, Pinar del Rio

In the course of fieldwork in the province of Pinar del Rio in western Cuba the second author collected a distinctive species of *Illicium* sect. *Cymbostemon* (see Morris et al. 2007) on the slopes of Pan de Guajaibón, on the western edge of the Sierra del Rosario. Subsequent study of these specimens (along with herbarium material of *Illicium cubense* A.C. Smith occurring in both western and eastern Cuba, as well as *I. ekmanii* A.C. Smith, *I. floridanum* J. Ellis, *I. hottense* Guerrero, Judd & A.B. Morris, and *I. parviflorum* Michx. ex Vent., all of which belong to sect. *Cymbostemon*) have led to the realization that these Pan de Guajaibón plants, which had been described as a subspecies of *Illicium cubense* (Imkhanitskaya 1993; i.e., *I. cubense* subsp. *guajaibonense*), are better understood as a distinct species. Thus, we propose here the new combination *Illicium guajaibonense* for this distinctive Pinar del Rio entity.

Illicium cubense, a Cuban endemic, was considered by Imkhanitskaya (1993) to be widely distributed on the island, and she grouped its rather variable populations into five subspecies. Our observations (based on 29 collections, excluding duplicates) suggest that these four subspecies, in addition to *I. cubense* subsp. *guajaibonense*, have consistent morphological differences (among many other polymorphic features) that correlate with their geographical distributions, and they are thus easily diagnosed. As discussed in more detail below, we found the epidermal features of the petiole and young stem to be especially useful in diagnosing these entities (although distinctive floral features also occur in subsp. *guajaibonense*). Of these subspecies, *I. cubense* subsp. *rangelense* Imkhanitskaya, like subsp. *guajaibonense*, is restricted to western Cuba, where it is restricted to the Sierra del Rosario, near Rangel. *Illicium cubense* subsp. *cubense*, subsp. *bissei* Imkhanitskaya, and subsp. *guantanamense* Imkhanitskaya are endemic to the mountains of eastern Cuba, with subsp. *cubense* occurring in the Sierra Maestra, including the Gran Piedra range (southern "Oriente"), subsp. *bissei* occurring in the Sierra de Nipe, Sierra de Cristal, Cuchillas de Moa, Sierra Mina de Iberia, Cuchillas de Toa, and Cuchillas de Baracoa (all in northern "Oriente"), and subsp. *guantanamense* occurring in the Sierra de Purial, Sierra de Imías, and the Meseta del Guaso (prov. Guantánamo).

Taxonomic reconsideration of the status of these remaining subspecies of *Illicium cubense* must await field investigations and the study of additional specimens (especially of material in Cuban institutions) of the taxonomically difficult eastern Cuban entities (subsp. *bissei*, subsp. *cubense*, and subsp. *guantanamense*) as well as the western Cuban taxon, *I. cubense* subsp. *rangelense*. The latter is especially poorly collected, and field studies of all of these entities would also be of value in working out the systematics of these plants (and such studies are currently underway; Alejandro Palmarola B., personal communication). Thus, we restrict our current focus to *I. guajaibonense*, since for this Pinar del Rio endemic we have adequate material to understand its pattern of variation. Our additional collections (and especially the field observations of J.R.A.) allow *I. guajaibonense* to be described in more detail than previously has been possible, and it is now readily distinguished from the various entities provisionally retained within *I. cubense*. We thus provide a full description and a new combination below, along with a discussion of morphological features that distinguish this new species from *I. cubense*. Finally, we note that our preliminary studies suggest that all of the subspecies of *I. cubense* may be better treated at the species level, and these subspecies are briefly compared.

In the following description we have based measurements on leaves that are presumably fully expanded, avoiding leaves at the apex of shoots if they are smaller than nearby leaves; we note that young leaves often dry a different color than adult leaves. The measurements of both vegetative and floral parts are based on dried herbarium material.

Illicium guajaibonense (Imkhanitskaya) Judd & Abbott, comb. et stat. nov. (**Fig. 1**). *Illicium cubense* A.C. Smith subsp. *guajaibonense* Imkhanitskaya, Bot. Zhur. 78:2. 1993. TYPE: CUBA. PROV. PINAR DEL RÍO: northern slopes of Pan de Guajaibón, 16 May 1953, *Bro. Alain & J. Acuña 2972* (HOLOTYPE: HAC, n.v.; ISOTYPE: GH).

Shrub to ca. 2 m tall; bark grayish brown, slightly fissured; young stems brownish to grayish, 1.6–2.7 mm in diameter near the lowest leaves, ± terete to obscurely angled, with decurrent ridge below some nodes, the surface smooth (although lightly to heavily wrinkled on drying) with rectangular epidermal cells that are neither papillate nor bullate. *Petiole* (0.7–)1.1–1.3 mm in diameter near middle, slightly wider and swollen at point of attachment to stem, narrowing to midrib, but difficult to delimit because blade often slightly decurrent onto petiole, drying dark (blackish), 4–10 mm long, excluding apical portion with obvious laminal flange, although there are often slight ridges on either side of the petiole adaxially, smooth, at least when fresh, wrinkled on drying, the epidermal cells neither bullate nor papillate, sometimes arranged in transverse rows; leaf blade thinly coriaceous, somewhat crisply succulent when fresh, and not particularly tough or fibrous, fragmenting readily when dry, light green abaxially when fresh but reddish brown when dried, dark green adaxially when fresh, more or less shiny (due to waxy cuticle) but dull grayish brown with pale greenish tinge when dried, generally ± elliptic to elliptic-obovate, occasionally ovate (the widest point mostly at or above the middle, sometimes parallel sided for about 10 mm near mid-leaf), 3.4–9.5 cm long, 1.4–4.2 cm wide, the base acute to cuneate, forming a 25–45° angle, often with a small flange of decurrent tissue along the upper petiole, the apex mostly ± acute, sometimes obtuse and bluntly rounded, forming a 30–45(–70)° angle, rarely with a small emarginate indentation; margin minutely revolute, either uniform throughout or the revolute portion slightly wider at base and narrowing toward apex, sometimes the extreme apex with margin plane; midvein shallowly sunken above, becoming more or less flush with the blade near the apex, when dried often inconspicuous for the apical 4–15 mm, slightly darker than blade, strongly raised below, very rounded near base, becoming flattened and less distinct towards apex, although usually clearly visible all the way to the tip, concolorous with blade to much darker, with epidermal cells nearly isodiametric near base, ranging to rectangular and then very elongate towards mid-leaf and apex, the secondary veins

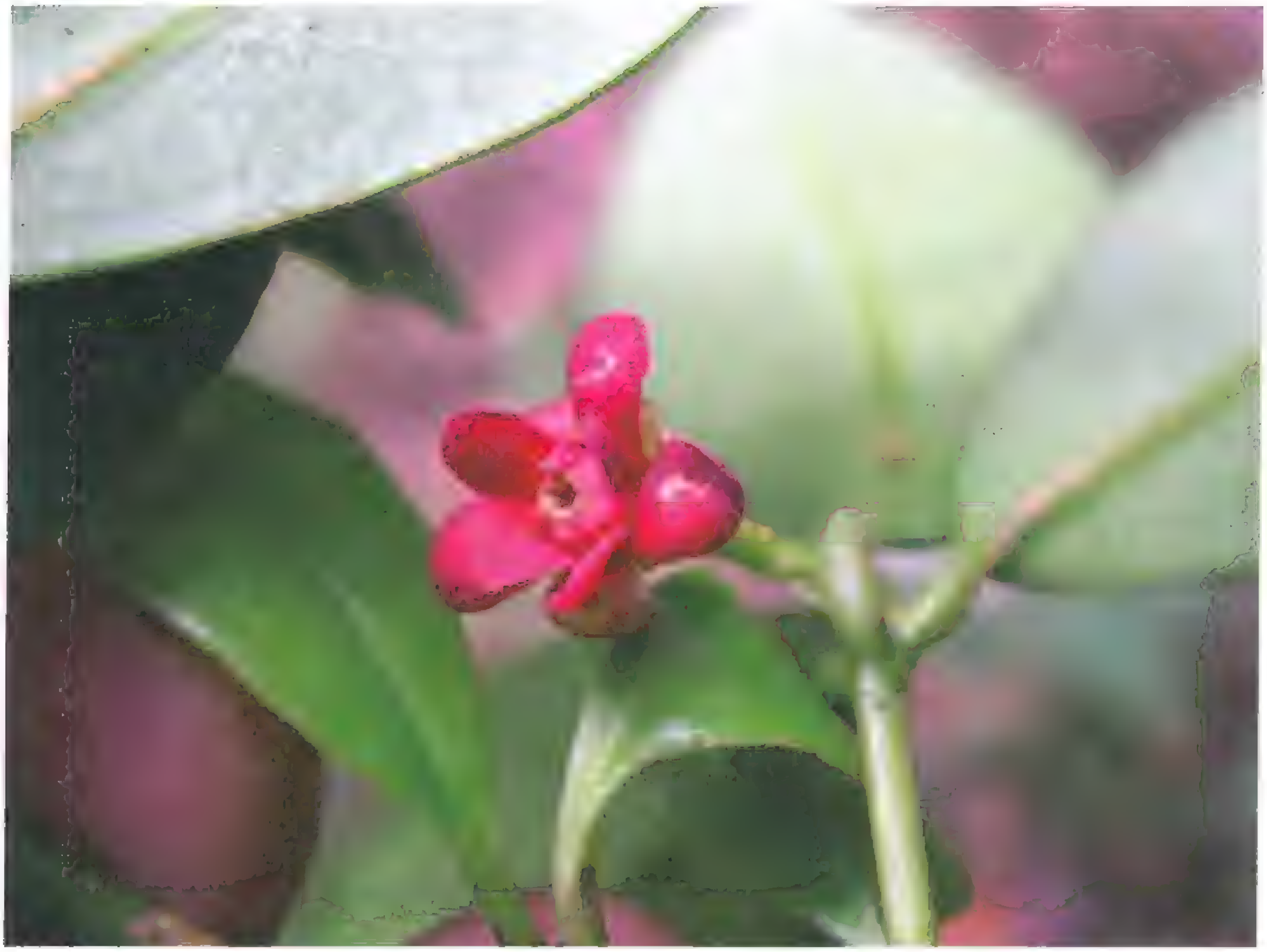

Fig. 1. ***Illicium guajaibonense,*** **on slopes of Pan de Guajaibón, Cuba (*Abbott 18885*).**

obscure (not visible on many leaves), but at least a few leaves with 2–5 visible secondary veins per side (but generally only a small portion of the proximal part of the vein visible), loosely looping together near the margin (i.e., brochidodromous) and with irregularly developed and only poorly visible tertiary veins (but these only seen with transmitted light), with spicy sweet, non-anise fragrance when crushed. *Flowers* axillary, but inflorescences distally clustered on branches and thus appearing terminal, with 1–4 inflorescences per stem, although apparently only one at a time with open flowers, the flowers 1–3 per cluster; subtending bracts (in tight cluster at base of pedicel) (3–)4–5, rounded ovate, sometimes broadly so, ca. 0.5 × 0.8 mm, the margin ciliate to nearly entire, persistent through anthesis, but perhaps deciduous in fruit. *Pedicels* slender, ca. 0.7 mm wide near middle, sometimes nearly the same width from base to apex, but usually widest at base and narrowing to apex, 6–11 mm long at anthesis, nearly straight to recurved, flexuous; with 0–3 bracteoles, usually 1 or 2 of these near pedicel base and 1 near apex, broadly rounded-ovate, but curved around pedicel and sometimes appearing ± triangular in side view, 0.6–1 × 1–1.2 mm, the margin ciliate. *Perianth segments* (tepals) 12–16, the 3–5 outermost tepals similar to large bracteoles, greenish (when fresh), broadly rounded-ovate to somewhat bluntly triangular, 1.2–1.8 mm long, 1.7–2.5 mm wide, with margin ciliate, the next 5–8 tepals much larger, 4.5–7.6 mm long, 2.5–4.1 mm wide, red (or the outermost ones red and mottled with green or pale brown), non-papillose, obovate to lingulate to sometimes slightly unguiculate (i.e., somewhat clawed at base, with narrow, pinched-in portion above extreme base), recurved-spreading, weakly concave to convex adaxially, with margin ciliate (outermost) to entire (innermost), and 2 or 3 of this set often cupped near the upper margins, the innermost 3–5 tepals grading into the stamens in size (and 1 or 2 may even be stamen-like, with non-functional thecae), same color and shape as larger tepals, although none cupped or ciliate margined; generally the outermost greenish tepals persist after the reddish, petaloid tepals and stamens have fallen, the surface of the tepals mostly smooth except for drying-related wrinkles, with glandular idioblasts apparent as lighter punctations. *Stamens* 5–7, uniseriate, except for 1 or 2 that are sometimes intermediate with tepals, 3.3–3.7 mm long, 1–1.7 mm wide, carnose (i.e., thicker and fleshier than the tepals when fresh, although not apparently so when dried), red, the filaments laminar, the anthers poorly developed, with thecae introrse, sub-immersed in the connective tissue, ca. 0.8 mm long, narrowing to a truncate apex. *Carpels* 7–8 in a single, tight, ring-like whorl, 2.5–3 mm long, the ovary laterally compressed, curving inwards above; style 0.8–1.2 mm long, erect to curved-spreading. *Fruits* and *seeds* not known.

Distribution and ecology.—*Illicium guajaibonense* is endemic to Pinar del Rio, Cuba, where it has been collected on the slopes of Pan de Guajaibón (at the western edge of the Sierra del Rosario) at 500–600 m elevation, and at Loma Español, San Cristobal. At the Pan de Guajaibón locality the species occurs on bauxitic soil in mesophyllous evergreen forest with *Adiantum* spp., *Blechnum fragile* (Liebm.) C.V. Morton & Lellinger, *Buchenavia tetraphylla* (Aublet) R.A. Howard, *Brysonima* sp., *Calophyllum antillanum* Britton, *Citharexylum* sp., *Cyathea arborea* (L.) Sm., *Cyrilla* sp., *Daphnopsis* sp., *Dendropanax arboreus* (L.) Decne. & Planch., *Lagetta wrightiana* Krug & Urb., *Matayba apetala* Radlk., *Mecranium haemanthum* Triana ex Cogn., *Miconia prasina* (Sw.) DC., *Ocotea leucoxylon* (Sw.) Laness., *Odontosoria* sp., *Ouratea elliptica* (A. Rich.) M. Gómez, *Pachyanthus tetramerus* Urb. & Ekman, *Polystichum wrightii* (Baker) C. Christensen ex Maxon, *Pseudolmedia* sp., *Sagraea capillaris* DC., *Selaginella* spp., *Talipariti elatum* (Sw.) Fryxell, *Ternstroemia* sp., and *Trichomanes scandens* L.

Phenology.—Flowering material has been collected in May and July.

Additional collections. **CUBA. Pinar del Rio Prov.:** Pan de Guajaibón, western edge of Sierra del Rosario, on the northern slopes near old military barracks a little below the summit, 500–600 m, between 22°47'17"N, 83°22'5.8"W and 22°47'23.6"N, 83°21'59.5"W (WGS 84 map datum), 8 May 2004 (fl) *Abbott 18885, with Bécquer* (FLAS, HAJB, NY, S, US); Loma Español, San Cristobal, 6 Jul, 1860–1864 (fl) *Wright 1844* (GH).

DISCUSSION

Illicium guajaibonense belongs in the *I. parviflorum* complex, within *Illicium* sect. *Cymbostemon* (as recircumscribed by Morris et al. 2007) because its stamens have conspicuously thickened filaments and sub-immersed anther thecae. We note that the monophyly of this clade is also supported by molecular data (Morris et al. 2007). Vegetatively, it can be distinguished from the various entities retained within *I. cubense* subsp. *cubense*, subsp. *bissei*, and subsp. *rangelense* by the smooth epidermis of its petioles (vs. microbullate, micropapillate, or tuberculate-papillate; Fig. 2), smooth epidermis of its young stems (vs. micropapillate to tuberculate-papillate, rarely microbullate or nearly smooth), and only shortly and apically flanged petioles (vs. petioles with flange of lamina tissue extending to near base); see Table 1 for a more detailed comparison of these taxa. The flowers of *Illicium guajaibonense* have red, obovate to lingulate inner tepals, which are recurved-spreading and adaxially weakly concave to convex, and stamens narrowed to a truncate apex (Fig. 1), while those of *I. cubense* subsp. *cubense* and subsp. *bissei* (Fig. 3) have yellowish green, suborbicular to elliptic or ovate, adaxially concave, non-recurved tepals, and stamens abruptly narrowed to a differentiated, obtuse-rounded apex. The stamens of *I. guajaibonense* are red while those of *I. cubense* subsp. *bissei* are peach-orange with the apical portion purple-tinged; stamen color has not been recorded in subsp. *cubense*. The flowers of *I. cubense* subsp. *rangelense* are poorly known, but the tepals of this taxon are broadly ovate to elongate-elliptic, oblong, or obovate, and also somewhat spreading, and the stamens are narrowed to a truncate apex. Thus, the flowers of subsp. *rangelense* may be more similar to those of *I. guajaibonense* than to the populations of *I. cubense* from eastern Cuba; unfortunately, the color of the tepals and stamens is unknown in subsp. *rangelense*, and observations of living flowers are required in order to accurately record tepal shape/curvature.

Illicium guajaibonense can be distinguished from the poorly known *I. cubense* subsp. *guantanamense* by its red (vs. yellowish green) flowers; we have not compared the vegetative characters of *I. guajaibonense* with *I. cubense* subsp. *guantanamense* as we have not seen herbarium material of this rarely collected taxon.

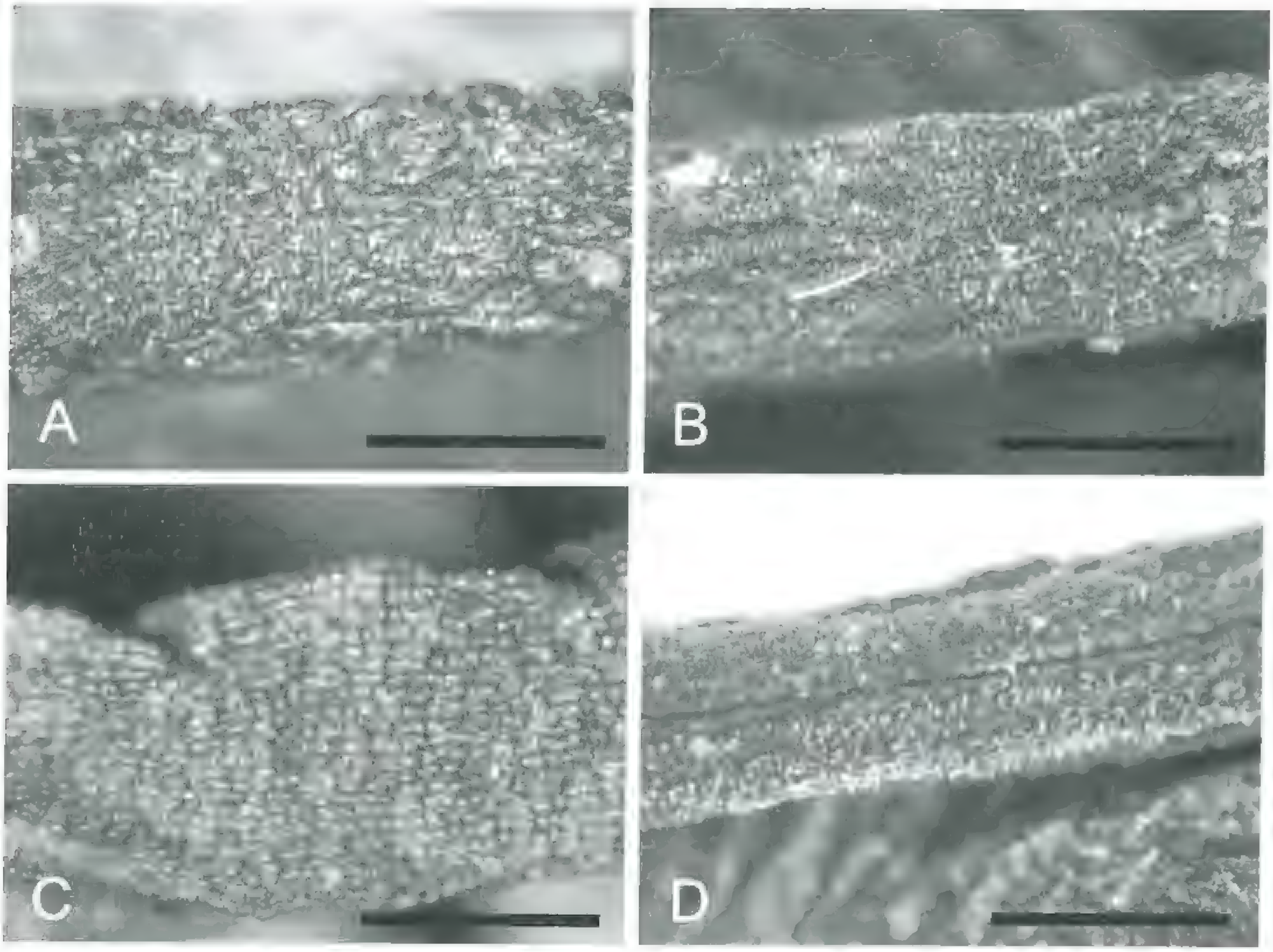

Fig. 2. Variation in form of epidermal cells of the petiole. A. *I. guajaibonense* (smooth; *Abbott 18885*, FLAS). B. *I. cubense* subsp. *cubense* (micropapillate; *Bro. Clemente 6477*, GH). C. *I. cubense* subsp. *bissei* (microbullate; *Bro. Alain & Figueiras 4536*, GH). D. *I. cubense* subsp. *rangelense* (tuberculate-papillate; *Bro. Alain 536*, GH). Black bar = 1 mm.

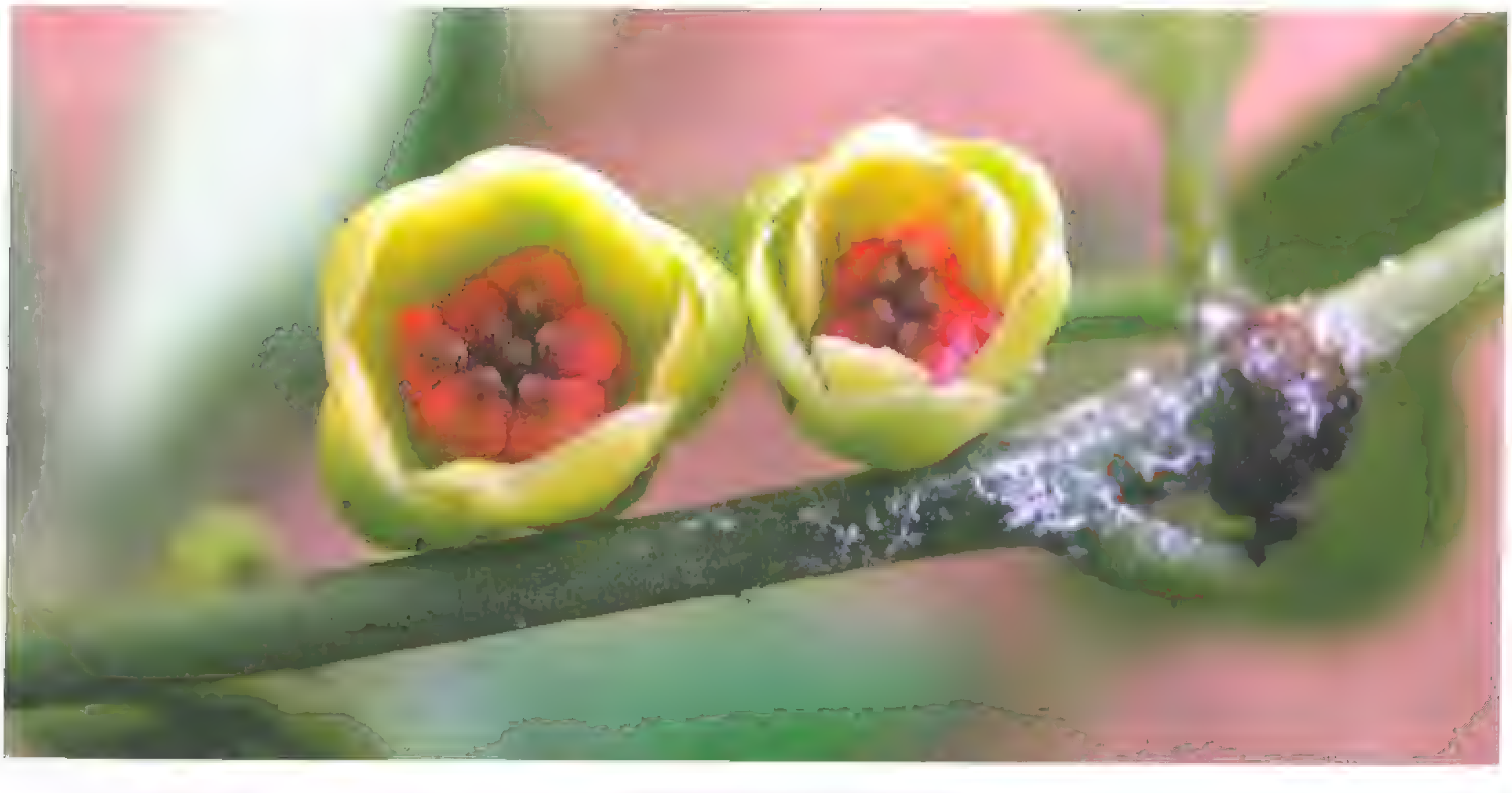

Fig. 3. *Illicium cubense* subsp. *bissei*, from the Alto de la Torre, Sierra de Nipe, Prov. de Holguín, Cuba (*Abbott 18953*).

Table 1. Morphological characters best distinguishing the Cuban taxa of *Illicium*. *Illicium cubense* subsp. *guantanamense* not included (due to lack of available material).

Taxon	**I. cubense subsp. bissei**	**I. cubense subsp. cubense**	**I. guajaibonense**	**I. cubense subsp. rangelense**
Petiole flange	to near base	to near base	only short, apical flange	to near base
Petiole texture	microbullate (Fig. 2C)	micropapillate (Fig. 2B)	smooth (Fig. 2A)	tuberculate-papillate (Fig. 2D)
Stem texture	micropapillate (rarely microbullate near nodes)	micropapillate (to nearly smooth)	smooth	tuberculate- papillate (some narrow, sharp-pointed)
Young stem (dried condition)	micro-ridges	micro-ridges	wrinkled (smooth when fresh)	micro-ridges
Stem epidermal cells	isodiametric	isodiametric to elongate	isodiametric to rectangular	elongate
Leaf margin	revolute (blade sometimes also cupped)	revolute (blade flat)	revolute (blade flat)	revolute (blade mostly flat, sometimes slightly cupped)
Secondary veins abaxially	obscure (mostly not visible except on some specimens with wide shade leaves)	obscure (mostly not visible)	generally visible, especially on largest leaves	obscure to sometimes visible
Flower color; Inner tepal shape	yellowish green; sub-orbicular to, ovate or elliptic and non-recurved	yellowish green; sub-orbicular to ovate or elliptic, and non-recurved	red; obovate to lingulate, and recurved-spreading	color not recorded; ovate to elongate-elliptic, oblong, or obovate, and spreading

Illicium cubense primarily occurs in the mountains of eastern Cuba, but subsp. *rangelense*, like *I. guajaibonense*, is endemic to western Cuba. *Illicium cubense* subsp. *rangelense* is phenetically distinctive due to its tuberculate-papillate stems and petioles, and on some plants the papillae are even narrowed and sharply pointed apically, looking like minute hairs (Fig. 2D). Additionally, the flowers of subsp. *rangelense*, as noted above, are quite different from those of the eastern populations of *I. cubense*. Thus, *I. cubense* subsp. *rangelense*, like *I. guajaibonense*, is easily distinguished from the other *Illicium* populations of Cuba. Were subsp. *rangelense* better known, we also would have proposed raising it to specific rank, as both seem to be amply distinct from each other, as well as from the populations of *I. cubense* from eastern Cuba. Unfortunately, it has been poorly collected, and (as noted above) the flower color is unknown. The status of subsp. *rangelense* is currently being investigated by A. Palmarola B. (as part of his revisionary study of *Illicium* in Cuba).

Illicium guajaibonense can be distinguished from *Illicium parviflorum* (of peninsular Florida; see Guerrero 1997) by its nearly unflanged (vs. ± flanged) petioles, leaves with a spicy, sweet (vs. anise) fragrance, differently shaped, red (vs. pale yellow) inner tepals, and 7–8 (vs. 10–13) carpels. It can be differentiated easily from *I. floridanum* and *I. mexicanum* (both continental in distribution) because these two species have more numerous and much more elongated tepals, as well as more numerous carpels. Finally, it is also differentiated from the two Hispaniolan species, *I. ekmanii* and *I. hottense* (Guerrero et al. 2004) by its nearly unflanged (vs. ± flanged) petioles, and differently shaped, red tepals (vs. pale yellowish to pink or red tinged in *I. ekmanii*; yellowish, tinged basally with salmon-color or yellowish with peach margins in *I. hottense*). In addition *I. hottense* has outer tepals that are strongly papillate, i.e., the entire surface of the tepals is densely papillate. The perianth segments of *I. ekmanii* lack papillae or are only very slightly papillate, i.e., with sparse papillae in the central region of the tepals and not extending to margins. The tepals of *I. guajaibonense* are consistently non-papillate. The petioles of *I. ekmanii* are smooth or with sparse low papillae; those of *I. hottense* are smooth, with a few scattered bumps, or rarely microbullate.

Phylogenetic analyses using ITS, *trnL*, *trnL-F*, and *trnG* sequence data (Morris et al. 2007) support the monophyly of the New World species of *Illicium*, i.e., section *Cymbostemon*, as re-circumscribed. Within this clade, *I. floridanum* and *I. mexicanum* are sister to a clade containing (among sampled taxa) *I. parviflorum*, *I. hottense*, *I. ekmanii*, *I. cubense* subsp. *bissei*, and *I. guajaibonense*, i.e., the *I. parviflorum* complex. These two clades, in addition to being well-supported by molecular characters (Bayesian posterior probabilities of 1.00 and 0.98, respectively), reflect very different floral morphologies (Imkhanitskaya 1993; Guerrero 1997), although we note that lingulate tepals have evolved independently in *I. guajaibonense* and in the common ancestor of the *I. floridanum* + *I. mexicana* clade. Within the *I. parviflorum* complex, molecular resolution is lacking due to short branch lengths, with each species exhibiting one to six autapomorphic DNA characters. This pattern is consistent with the differences among closely related species observed within the Old World clade (Morris et al. 2007), indicating that such differences provide additional support for species recognition. Furthermore, short branch lengths within the New World clade, relative to long branch lengths between the New and Old World clades, indicate recent speciation within this group, and suggest the possibility of a history of extinctions within *Illicium*.

Red flowers are undoubtedly autapomorphic for *Illicium guajaibonense*, and this morphological feature, along with the molecular autapomorphies indicated in Morris et al. (2007), indicate that it probably is, therefore, a cladospecies, satisfying the requirement of the apomorphy species concept (Donoghue 1985; Mishler & Theirot 2000; Judd et al. 2008). It is evident that *I. guajaibonense* also satisfies the morphological-phenetic (Judd 2007) and diagnostic (Wheeler & Platnick 2000) species concepts.

Although *Illicium guajaibonense* and *I. cubense* (with its various subspecies) are probably each other's closest relatives, as evidenced by the reduced number of carpels (Guerrero 1997), we believe that it is probable that *I. guajaibonense* represents a distinct evolutionary lineage (see de Queiroz 2007), which would be obscured by considering these Pan de Guajaibón plants within a broadly circumscribed *I. cubense*. The rank of subspecies has been used in various ways, but could be interpreted to imply that the boundaries between *I. guajaibonense* and the various entities within *I. cubense* are not entirely fixed. However, as we have shown, this is not the case for *I. guajaibonense*, which is amply and consistently distinct from the various entities within *I. cubensis* in both vegetative and reproductive characters. It is our view that the rank of subspecies should be used for geographical or ecological variants with demonstrable intergradation.

Illicium guajaibonense, which may now be limited to a small forested region on the Pan de Guajaibón, should be considered as "critically endangered" according to the guidelines of the IUCN red data book categories (Lucas & Synge 1978). The very small population should be protected from development.

Pending a detailed monographic study of New World *Illicium*, the following preliminary key (with treatment of *I. guantanamense*, for which we have not seen specimens, based on characters reported by Imkhanitskaya, 1993) is provided as an aid to the identification of the species and subspecies of *Illicium* occurring in Cuba.

1. Petioles and stems conspicuously tuberculate-papillate (i.e., with elongate, rounded to sharp projections from the epidermal cells; Fig. 2D; generally tightly packed but with scattered flat, smooth spots where the epidermal cells can be seen), with some papillae narrow and hair-like; plants of western Cuba (mountains near Rangel) ____ **I. cubense** subsp. **rangelense**

1. Petioles and stems microbullate, micropapillate, or smooth (apart from wrinkling related to drying), but never tuberculate-papillose.

2. Flowers with inner tepals bright red, obovate to lingulate, and recurved-spreading; petioles and young stems smooth (apart from wrinkling related to drying; Fig. 2A); plants of western Cuba (Pan de Guajaibón) ____ **I. guajaibonense**
2. Flowers with inner tepals yellowish green, suborbicular to elliptic or ovate, and non-recurved; petioles and young stems microbullate, micropapillate, or smooth (apart from wrinkling related to drying); plants of eastern Cuba.
   3. Petioles ± smooth; plants of prov. Guantánamo ____ **I. cubense** subsp. **guantanamense**
   3. Petioles microbullate or micropapillae; plants of eastern Cuba, prov. Granma, Holguín, Santiago de Cuba, and northern Guantánamo (Cuchillas de Baracoa).
      4. Petioles microbullate (i.e., swollen ends of nearly isodiametric epidermal cells producing continuous rows of low, rounded, regular, tightly packed, squarish protuberances; Fig. 2C); young stems micropapillate (sometimes microbullate near nodes); petiole flange usually to very base; leaves usually somewhat abaxially curved (to more or less flat in shade); plants of northern "Oriente" ____ **I. cubense** subsp. **bissei**
      4. Petioles micropapillate (i.e., small, rounded projections from the epidermal cells, with tiny, flat, smooth regions between the papillae; Fig. 2B); young stems micropapillate to sometimes ± smooth; petiole flange usually ends 1-2 mm above petiole base (usually with raised ridge lines continuing to base); leaves always ± flat; plants of southern "Oriente" ____ **I. cubense** subsp. **cubense**

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NEOCALYPTROCALYX MORII (CAPPARACEAE), A NEW SPECIES FROM CENTRAL FRENCH GUIANA

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ABSTRACT

We describe **Neocalyptrocalyx morii,** a distinctive localized endemic previously considered to be a local sporadic variant of *Capparis leprieurii*, restricted to French Guiana. The new species is characterized by alternate leaves, eight stamens and ovoid, yellowish ovaries when dried.

Key Words: Capparaceae, endemic, French Guiana, *Neocalyptrocalyx morii*

RÉSUMÉ

La nouvelle espèce **Neocalyptrocalyx morii,** endémique de la Guyane française, est décrite. Cette plante était auparavant considérée comme une variante locale, sporadique de *Capparis leprieurii*. Elle se caractérise par des feuilles alternées, huit étamines, et des ovaires ovoïdes et jaunâtres à l'état sec.

Neocalyptrocalyx Hutch. (1967) is a neotropical genus of Capparaceae that comprises seven species, ranging from the Amazonian lowlands of Brazil and Ecuador to the Guianas and eastern Venezuela. The genus was recently resurrected and its taxonomical limits clarified (Cornejo & Iltis 2008). While studying the species of *Neocalyptrocalyx*, we became aware that several collections from French Guiana, provisionally identified and cited as *Capparis leprieurii* Briq. (Iltis et al. 1996: 378; Iltis & Mori in Mori et al. [eds.], 2002, Fig. 66, pl. 38:e; also used by Iltis as a New Year's card, widely distributed in 1997), consistently differ by having flowers with 8(to 9) stamens, ovoid rather than oblongoid ovaries, and alternate leaves, representing a new species herewith described.

Neocalyptrocalyx morii Cornejo & Iltis, sp. nov. (**Fig. 1**). Type: FRENCH GUIANA: Saül and vicinity, Sentier Botanique, just E of Eaux Claires, ca. 500 m from entrance to trail, non-flooded moist forest, 3°37'N 53°12'W, ca. 300 m, 23 Sep 1994 (fl), *S. Mori, C. Gracie & C. Zinder 24021* (holotype: NY; isotypes: CAY, WIS).

Species *Neocalyptrocalyci nectareo* (Vell.) Hutch. et *Neocalyptrocalyci leprieurii* (Briq.) Iltis affinis, a quibus differt foliis alternatis, staminibus minoribus, 8(–9) et ovariis ovatis, flavidis-albidis (in sicco).

Tree to 45 m tall, trunk cylindric to base but not buttressed, sometimes angled, to 75 cm dbh, the outer bark smooth and light brown to light grayish-brown, the inner bark cream or yellow, slash yellow, emitting fetid aroma when cut; lepidote-stellate throughout. **Leaves** alternate; petioles 1–1.7(–2.3) cm; mature blades elliptic to oblong-elliptic or narrowly-obovate, 10–23 × 4–9(–11) cm, the base inconspicuously subcordate to broadly obtuse, the margin entire to repand, the apex acuminate, coriaceous (in vivo), chartaceous (in sicco), covered by lepidote-stellate hairs on both surfaces, glabrescent; and 9 to 13 main lateral veins on each side of the midrib. **Inflorescences** very short corymbose racemes on peduncles to 2 cm long, sometimes apparently subfasciculate due to the absence of a peduncle, terminal, axillary and ramiflorous; floral bracts linear, 1–2.5 mm, very soon deciduous; flower buds subspherical to widely elliptic nearly to anthesis; pedicels 10–27 mm. **Flowers** nocturnal, the outer **sepals** widely ovate to suborbicular, 7–15 × 7–9 mm, green to gray-green, entirely covering the flowerbud until anthesis, becoming widely divergent to reflexed at anthesis, the inner pair of sepals ligulate-oblanceolate, ca. 6–10 × 2 mm; **petals** obovate, 12–20 × 10–12 mm, white, with cuneate base, wavy margin and rounded at the apex; **stamens** 8(–9), with filaments 13–25 mm, cream to creamy-white (in vivo), inserted in a single row, with hyaline uniseriate trichomes at the base, the anthers ca. 2 mm; gynophore 13–25 mm, cream to creamy-white (in vivo), the **ovary** ovoid, 2–3 × 2–3

J. Bot. Res. Inst. Texas 2(2): 807 – 810. 2008

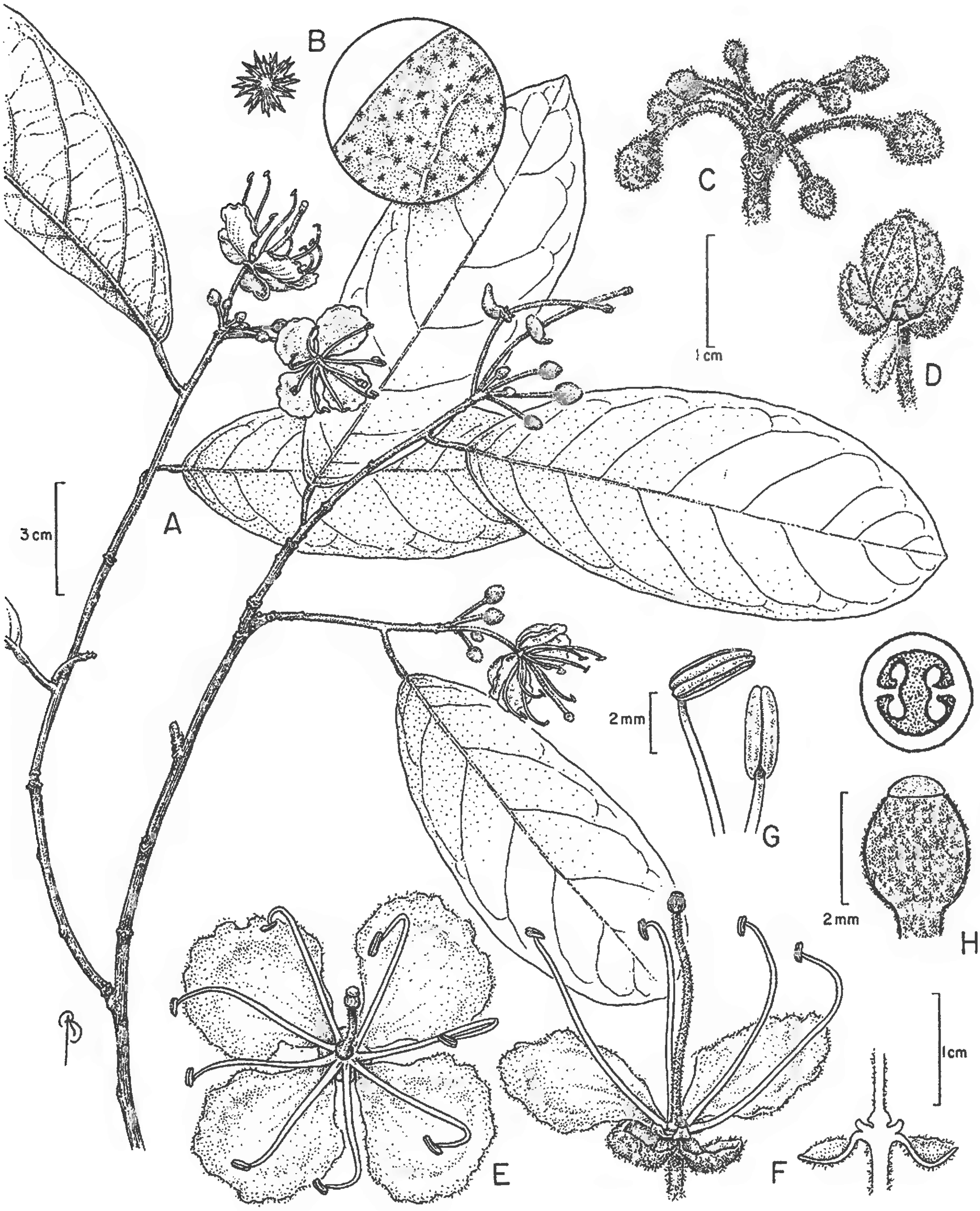

Fig. 1. *Neocalyptrocalyx morii*. **A.** Terminal branch with leaves and flowers. **B.** Detail of abaxial surface of nearly fully expanded leaf (right) and enlargement of stellate-lepidote trichome (left). **C.** Inflorescence in bud. **D.** Mature bud with inner sepal pulled down to show nectar scale. **E.** Apical view of flower. **F.** Lateral view of flower with two petals and four stamens removed (left), median section of pistil (right), and transverse section of ovary (above). **G.** Lateral (far left) and abaxial (near left) views of anthers. **H.** Lateral view of ovary and stigma (below) and transverse section of ovary (above). (From Iltis & Mori in Mori et al. [eds.] 2002: 187, fig. 66. The ovaries and number of stamens modified by the first author.

mm, yellowish, the gynophore and ovary are densely covered with whitish-stellate trichomes, the stigma capitate, sessile, green, turning red at post-anthesis. **Fruits** unknown.

Additional specimens examined: **FRENCH GUIANA. St. Elie:** Piste de St. Elie, interfluve Sinnamary/Counamama, 5°20'N 53°0'W, arbre IV-578, 5 Oct 1992 (fl), *Sabatier & Prévost 4084* (CAY [not seen], WIS [2]); Station de la Piste de St. Elie (ECEREX), Parcelle PSEIV (km 16,3), 5°17'N 53°3'W, 6 Nov 2003 (fl), *Prévost & Sabatier 4791* (CAY [not seen], NY). **Saül:** Monts La Fumée, Antenne Norte, 9 Oct. 1982 (fl), *Prance & Boeke 28085* (CAY [not seen], NY); voucher for ecological study: Tree 81, 3°37'N 53°12'W, 200–400 m, 15 Sep 1982 (fl), *Boom & Mori 1697* (MO [not seen], NY); voucher for ecological study: Tree 173, 3°37'N 53°12'W, 200–400 m, 24 Sep 1982 (st), *Boom & Mori 1813*(NY); voucher for ecological study: Tree 227, 3°37'N 53°12'W, 200–400 m, 25 Sep 1982 (st), *Boom & Mori 1841*(NY); voucher for ecological study: Tree 262, 3°37'N 53°12'W, 200–400 m, 7 Oct 1982 (fl), *Boom & Mori 1897* (NY); voucher for ecological study: Tree 271, 3°37'N 53°12'W, 200–400 m, 8 Oct 1982 (fl), *Boom & Mori 1904* (CAY [not seen], NY); voucher for ecological study: Tree 274, 3°37'N 53°12'W, 200–400 m, 8 Oct 1982 (st), *Boom & Mori 1909* (NY); voucher for ecological study: Tree 280, 3°37'N 53°12'W, 200–400 m, 8 Oct 1982 (st), *Boom & Mori 1914* (NY); voucher for ecological study: Tree 284, 3°37'N 53°12'W, 200–400 m, 8 Oct 1982 (st), *Boom & Mori 1917* (NY); voucher for ecological study: Tree 416, 3°37'N 53°12'W, 200–400 m, 14 Oct 1982 (st), *Boom & Mori 2062*(NY). Vicinity of Eaux Claires, on the Sentier Botanique, on upper part of gentle slope to the plateau, ca. 300–350 m, 12 Oct 1991 (fl), *Mori & Gracie 22096* (CAY [not seen], NY, WIS). **Saül and vicinity:** Sentier Botanique, entrance just E of Eaux Claires, less than 800 m from entrance, tree 460–3, 3°37'N 53°12'W, 250–350 m, 12 Sep 1994 (st), *Mori et al. 23897* (NY).

In *Neocalyptrocalyx* the number of stamens is one of the helpful characters to differentiate species. Thus, *Neocalyptrocalyx nectareus*, *N. leprieurii* and *N. grandipetala* have flowers with 16 to 18 stamens, *N. eichlerianus* has flowers with 30 to 37 stamens, these four species have the stamens inserted in two rows. However, *Neocalyptrocalyx morii* has 8(to 9) stamens inserted in a single row. *Neocalyptrocalyx maroniensis* has flowers with 10 to 20 stamens inserted in one to two rows, but the flowers of the latter species are distinctively smaller. It is interesting to note that eight stamens is one of the characters for several well-defined species among the neotropical Capparaceae with variously stellate indumenta (e.g. *Capparicordis crotonoides* [Kunth] Iltis & Cornejo, *Quadrella lundellii* [Standl.] Iltis & Cornejo, *Q. morenoi* Cornejo & Iltis, and *Q. steyermarkii* [Standl.] Iltis & Cornejo). A second character to reinforce the recognition of this species is that among the neotropical species of Capparaceae, the shape and color of the ovaries in dried material do not show conspicuous variability. *Neocalyptrocalyx nectareus* and *N. leprieurii* have ovaries oblong-cylindrical and brown (when dried), but the ovaries of *N. morii* are ovoid and yellowish (when dried). In addition, *Neocalyptrocalyx morii* has alternate leaves, while *N. nectareus* and *N. leprieurii* usually have spiral leaves. Several of the studied collections have been previously identified as a local variant of *Neocalyptrocalyx leprieurii*, but none of the studied specimens shows intermediate floral features between *N. leprieurii* and *N. morii*. These morphological differences correlated with the uniform geographical distribution of the studied collections lead us to recognize *Neocalyptrocalyx morii* as a distinct new species.

Etymology.—We are pleased to name this new species in honor of Scott A. Mori, the distinguished specialist on neotropical Lecythidaceae, who collected the type (see details in Iltis et al. 1996: 378), and the main editor of Guide to the vascular plants of central French Guiana.

Habitat and Distribution.—Common but scattered in well-drained tropical moist forests of Saul and St. Elie, French Guiana.

Phenology.—This nocturnal and presumably bat-pollinated species has been collected with flowers from September to November.

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A NEW SPECIES OF *LASIOLAENA* (ASTERACEAE: EUPATORIEAE: GYPTIDINAE) FROM BAHIA, BRAZIL

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ABSTRACT

Lasiolaena is an endemic genus of the Bahia state and previously included six described species. The most distinctive features of *Lasiolaena* are the spirally arranged leaves, the tomentum on the stems, leaves and involucres, and the flattened bristles of the pappus. The new species of *Lasiolaena* has a different suite of vegetative and floral characters from all the other known species. Leaves of **Lasiolaena lychnophorioides** are triangular, small (lamina 4–9 × 2–4 mm), with revolute margins, and sessile; the stems, lower leaf surface, and phyllaries are lanate; the conical receptacle is densely pilose and, finally, the pappus is formed by coarsely barbellate subulate bristles, and pinkish especially towards apex. The new species is described and illustrated and information concerning its habitat and phenology is presented.

Key Words: Asteraceae, Compositae, Brazil, *Lasiolaena*, Eupatorieae

RESUMEN

Lasiolaena es un género endémico del estado de Bahia que anteriormente incluía seis especies descriptas. Los caracteres más distintivos de *Lasiolaena* son las hojas dispuestas en forma espiralada, el tomento de los tallos, hojas e involucros y las cerdas del papus retorcidas. Una nueva especie de *Lasiolaena* tiene una morfología vegetativa y floral completamente diferente de todas las otras especies conocidas del género. Las hojas de **Lasiolaena lychnophorioides** son triangulares, pequeñas (lámina de 4–9 × 2–4 mm), revolutas y sésiles: los tallos, hojas y brácteas involucrales son lanosas; el receptáculo cónico es densamente piloso y, finalmente, el papus está formado por cerdas subuladas, notablemente barbeladas, rosado, especialmente hacia el ápice. La nueva especie es descripta e ilustrada y se presenta información relativa a su habitat y fenologia.

INTRODUCTION

Gyptidinae *s.l.* constitutes a complex and problematic subtribe and is, without doubt, polyphyletic (Hind & Robinson 2007). Basically it is characterized for the weakly distant phyllaries, persistent, the leaves opposite to spirally inserted, the capitula almost always with ten or more florets, and the pappus usually of many capillary or sometimes plumose bristles (King & Robinson 1972).

The greatest concentration of genera is in Brazil, especially in Northeast Brazil (Hind & Robinson 2007). Of the 29 genera and ca. 135 species in the subtribe, 24 genera have representatives in the Brazil, 20 are distributed in the State of Bahia, and nine genera are restricted to that state (King & Robinson 1987; Hind 1999a, 2000).

The genus *Lasiolaena* was established by King and Robinson (1972) in part of morphological and anatomical study that divided the artificial traditional concept of *Eupatorium* L. in 80 distinct genera. The most distinctive features of *Lasiolaena* are the spirally arranged leaves, the tomentum on the stems, leaves and involucres for which the genus is named, and the flattened bristles of the pappus. The conical receptacle of the genus was originally thought to indicate relationship to *Barrosoa* R.M. King & H. Rob. and *Conocliniopsis* R.M. King & H. Rob., but this character occurs widely among various groups of genera in the Gyptidinae

J. Bot. Res. Inst. Texas 2(2): 811 – 815. 2008

(King & Robinson 1972, 1987). Later, King and Robinson (1987) and Hind (1999a, 2000) discussed the closest relationships of *Lasiolaena* with *Agrianthus* Mart. ex DC., *Catolesia* D.J.N. Hind, *Stylotrichium* Mattf. and *Bahianthus* R.M. King & H. Rob, all of which have densely spirally inserted leaves, but lack the flattened bristles of the pappus.

Although *Lasiolaena* is a small genus endemic to the State of Bahia and where most of six species were described in the last 40 years, not all the species are adequately distinguished in the keys provided by Hind (1999b), and Oliveira (2006). The characters used as diagnostic, including the density of trichomes in the corolla lobes, lamina, cypselae, and the length of the pappus bristles are not adequately tested. Consequently, many newer specimens of *Lasiolaena* in herbaria are misdetermined.

Recently, we have collected a new species of *Lasiolaena* which has completely different vegetative and floral morphology from all the known species. Here we describe the new species and include comments about its habitat and phenology.

MATERIALS AND METHODS

The data presented are based on literature revisions and an analysis of *Lasiolaena* collections and types available in herbaria ALCB, CEPEC, HRB, MBM, R, RB, SP, SPF, UEFS and US. Morphological studies using Olympus SZH10 stereomicroscope were carried out on dried material.

TAXONOMIC TREATMENT

Lasiolaena lychnophorioides Roque, Ferreira & H. Rob., sp. nov. (**Fig. 1–2**). Type: BRAZIL: Bahia: Município de Mucugê, Serra do Gobira, 13°5'S, 41°22'W, 16 Sep 2006, *A.A. Conceição, D. Cardoso & E.R. Souza 1878* (holotype: HUEFS!; isotypes: ALCB!, K).

Ab omnibus speciebus generis ceterus caule ramisque atque foliorum pagina abaxialibus atque bractis involucralibus lanosis, foliis coriaceis, discoloribus, triangularibus, laminis 6–9 × 2–4 mm, margine revolutis, sessilibus; receptaculo conico, dense piloso, setis pappi lanceolatis, barbellatis, acuminatis et roseis versus apicem differt.

Shrub 0.6 to 1.5m tall. Stems branched, pseudoverticillate, usually densely leafy in distal parts, densely white-lanate. **Leaves** alternate, spirally arranged, coriaceous, discolorous, lamina 4–9 × 2–4 mm, triangular, apex acute, margins revolute, entire, base truncate to cordate, sessile, adaxial surface dark-green, glabrous since younger, white-lanate abaxially and cryptically glandular-punctate, glandular trichome multicellular, 5–7-seriate, venation obscure beneath. **Inflorescence** terminal, corymbiform, distinctly exceeding upper stem leaves, 3–9 short-pedunculate capitula, peduncles 2–5(–7) mm long, densely lanate, 1–3-bracteolate, bracteoles 3–4 × 0.3 mm, linear, apex acute, abaxial surface lanate; **capitula** discoid, homogamous; involucre campanulate, 7–10 mm tall × 6.5–8.5 mm diam., phyllaries 24–36, 4–6 × 1–1.5 mm, oblong-lanceolate, apex acute, 3–4-seriate, distant, subequal, abaxial surface lanate; receptacle conical, epaleaceous, densely pilose. **Florets** 30–36 per capitulum, bisexual, ca. 7 mm long; corolla pinkish, tube 3.5–4.0 mm long × 1 mm diam., cylindrical, moderately glandular-punctate; lobes 0.5–0.8 × ca. 0.4 mm, triangular, acute, sparsely glandular-punctate, inner surface of lobes mamillose; apical anther-appendages conspicuous, ca. 0.3 mm long, oblong-ovate, rounded; bases of anther thecae rounded; anther-collar flattened and thickened; style ca. 5 mm long, style-base lacking basal node, glabrous; style-arms 2.5 mm long, slightly clavate, conspicuously short-papillose. **Cypselae** prismatic, 2–5 mm long, 5-ribbed, body setuliferous, setulae or long 'twin-hairs', scarcely forked at apices, apices acute; carpopodium annuliform, obscurely procurrent on to base of ribs; pappus-bristles 20–22, uniseriate, subequal, persistent, 2–3.5 mm long, lanceolate, laciniate at the base, apices barbellate, acuminate into a bristle-like point, pinkish especially towards tip.

Additional specimens examined. **Brazil. Bahia:** Município de Mucugê, subida para o Morro do Gobira, 1400 m, 11 Dec 2003, *N. Roque s.n.* (ALCB 64605, 64770); Morro do Gobira, 13°5'38"S, 41°22'31"W, 04 Aug 2004, *E.L. Borba, A.C.S. Pereira, P.L. Ribeiro & O.A. Oliveira 1805* (HUEFS, K); Morro do Gobira, 13°5'38"S 41°22'31"W, 04 Aug 2004, *E.L. Borba, A.C.S. Pereira, P.L. Ribeiro & O.A. Oliveira 1813* (HUEFS, K); Serra do Gobira, platô, 13°5'57"S, 41°22'34"W, 15 Aug 2005, *E.C.Oliveria & A.K.A. Santos 106* (ALCB, IBGE, HUEFS, K); subida Sul para a Serra do Gobira, 08 Sep 2007, *S.C.Ferreira, A.L.A. Côrtes, M. Ibrahim & S.N. Monteiro 343* (HUEFS).

Distribution.—evidently endemic to the Mun. Mucugê, Chapada Diamantina, Bahia.
Habitat.—sandy soils in campos rupestres, often in scrubby hillside vegetation.

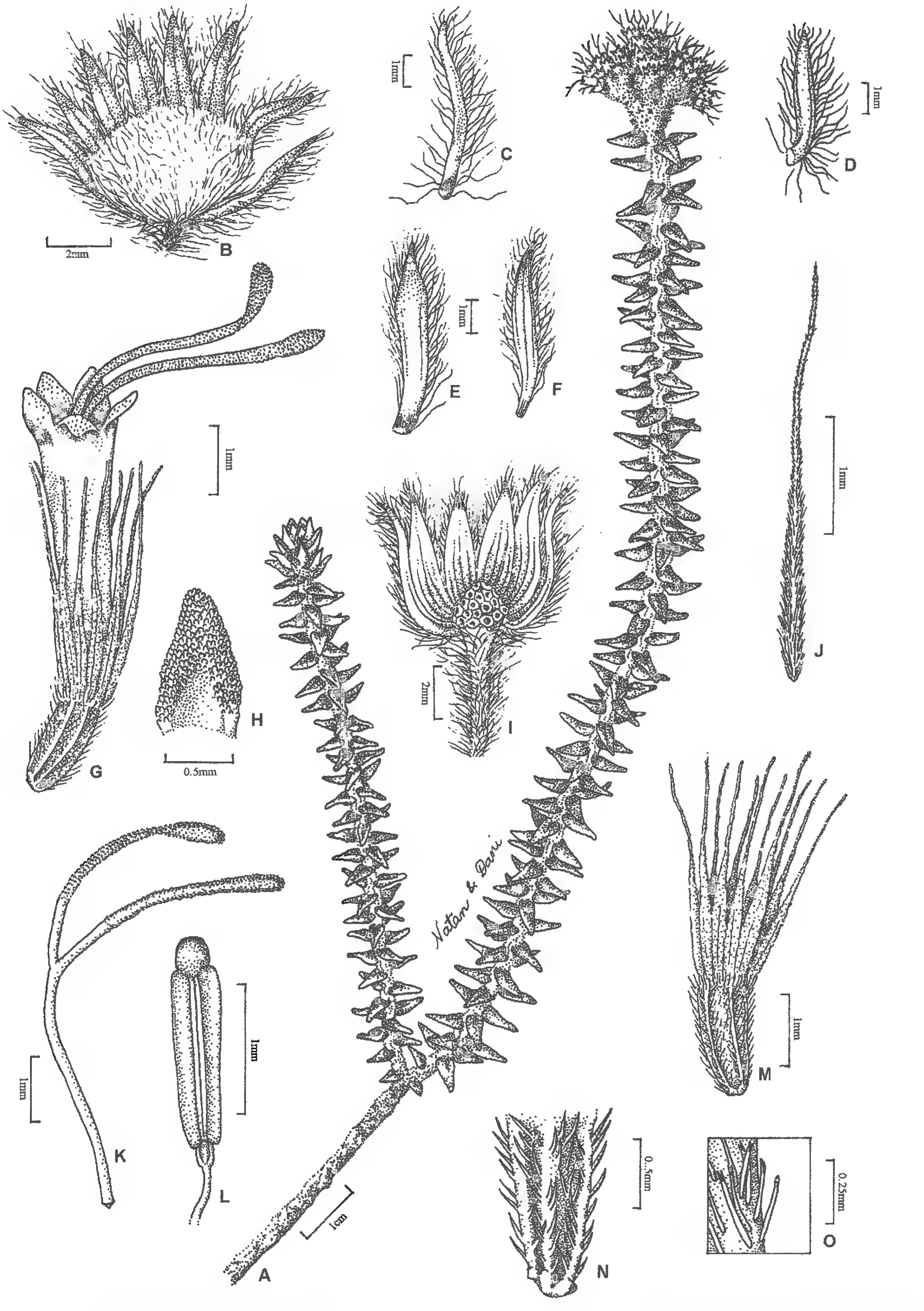
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Fig. 1. *Lasiolaena lychnophorioides (Borba et al. 1813)*. **A.** Habit. **B.** Densely pilose receptacle. **C.** Bracteole. **D.** Outer phyllary. **E.** Median phyllary. **F.** Inner phyllary. **G.** Floret. **H.** Mamillose lobe. **I.** Conical and epaleaceous receptacle (removed indumentum). **J.** Barbellate, acuminate pappus-bristle. **K.** Style. **L.** Anther with rounded appendage. **M.** Cypsela and pappus. **N.** Carpopodium and 'twin-hairs'. **O.** 'Twin-hairs' in detail.

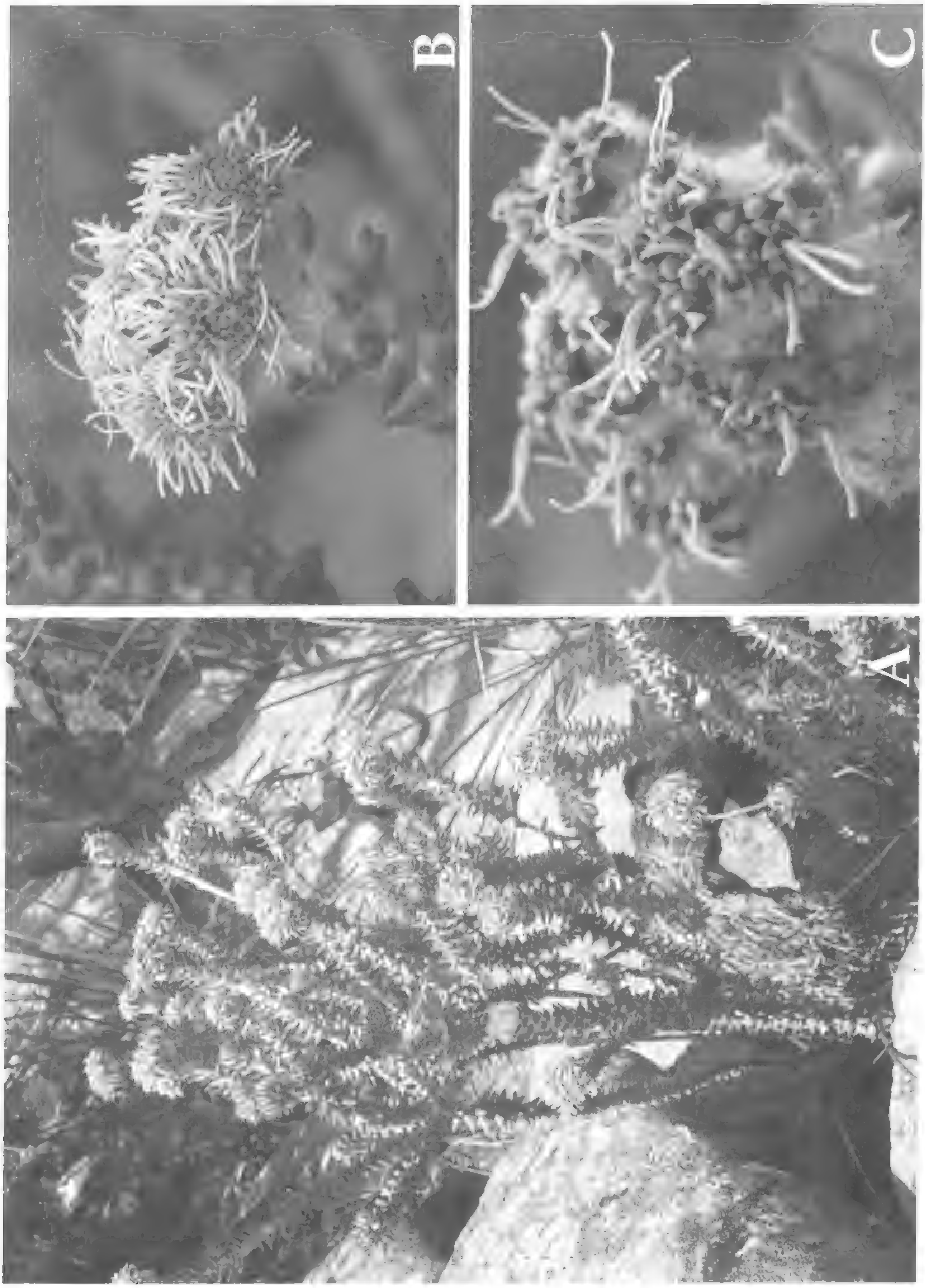

Fig. 2. *Lasiolaena lychnophorioides*. A. Shrub amongst rocks in campos rupestres vegetation. B. Inflorescence corymbiform on tips of leafy branches and leaves spirally arranged. C. Florets in details (phyllaries dense white tomentum). Pictures from Silvana C. Ferreira.

Phenology.—Flowering time: August–December.

Etymology.—The species is named for its similarity in habit to some *Lychnophora* species from Bahia.

DISCUSSION

Lasiolaena lychnophorioides has spirally arranged leaves, a character very common in a number of genera of the Gyptidinae. Some characters as persistent indumentum (stems, abaxial leaf face and involucre), corymbiform inflorescence, conical receptacle with trichomes (except *L. carvalhoi*) and pappus-bristles barbellate, acute to acuminate, have reinforced the generic position adopted by the authors. On the other hand, it has a set of distinctive morphological characters when compared with others species of *Lasiolaena*.

The leaves are coriaceous, discolorous, triangular, revolute and sessile. Revolute leaves are unknown in *Lasiolaena* and indeed in the Gyptidinae. This specific feature is very common in some species of *Lychnophora* (Vernonieae) from Bahia, as *Lychnophora phylicifolia*, *L. blanchetii*, *L. regis* and *L. triflora*, revealing how interesting are the convergent processes inside this family. Moreover, the stems, abaxial leaf surfaces and phyllaries of *Lasiolaena lychnophorioides* are white-lanate, and not tomentose or puberulous, as commonly observed in other species of the genus. The conical receptacle is densely pilose in the new species, what is unknown in *Lasiolaena* and rare in Gyptidinae. Finally, the pappus is formed by lanceolate, coarsely barbellate bristles, which are pinkish, especially towards their tips.

Lasiolaena is one of the most distinctive genera of the Gyptidinae in the campos rupestres of Bahia, and it occurs in small, geographically restricted populations. It is a prime candidate for studies on population genetics and morphology that may be useful in measuring the level of variability in the species and help establish conservation strategies.

A phylogenetic study based on molecular data including 24 genera of this subtribe is under progress at University of Feira de Santana, Brazil. Its main goal is to provide the first assessment of phylogenetic relationships among the Gyptidinae genera. Data from these results will help determine if Gyptidinae includes at least three distinct clades, each representing a separate subtribe, as suggested by Hind and Robinson (2007).

ACKNOWLEDGMENTS

We are grateful to Cássio Van den Berg for the Latin diagnoses and Paulo Takeo Sano for comments. We also thank Natanael Nascimento and Daniela Guimarães for the illustration plate. Special thanks go to two reviewers for useful suggestions and critical reading of the manuscript.

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BOOK REVIEW

DIANA TITTLE, with photographs by IAN ADAMS and JENNIE JONES. 2005. **A Paradise in the City: Cleveland Botanical Garden.** (ISBN 978-1882203461, hbk.). Orange Frazer Press, P.O. Box 214, Wilmington, Ohio 45177, U.S.A. (**Orders:** www.orangefrazer.com, 800-852-9332, or Cleveland Botanical Garden Store, 11030 East Boulevard, Cleveland, Ohio 44106, www.cbgarden.org, 216-707-2800). $39.95, 160 pp., color photographs, 12" × 9".

Contents:

Foreword (by Brian E. Holley, Executive Director of Cleveland Botanical Garden)
1. Baobab in the Garden
2. Land of Enchantment
3. Best Little Classroom in Ohio
4. Ideasource
5. Healing Presence
6. Good Neighbor
7. Paradeisos
8. Photography credits and author's interviews

A Paradise in the City is an appropriately titled, unique story of the magnificent Cleveland Botanical Garden (CBG). Word after word, as if in a poem, Diana Tittle describes all integral aspects of CBG, from the unique Eleanor Armstrong Smith Glasshouse, which houses plants from the arid environments of Africa, to the Costa Rican and Japanese gardens. The descriptions and wondrous photographs give us insight into an actual paradise in the city. Ohio residents have access to the rest of the world, essentially, from their own backyard.

Since its inception in 1930, CBG has become one of many leaders in the country. Upon reading this book I, along with many others I'm sure, have instantly become interested in what the garden has to offer. Tittle jumps from one characteristic to another while subtly incorporating actual experiences from people of all ages. There is no doubt that the garden has something to offer every individual whether they are five or seventy-five. In addition, the garden not only presents spectacular floral arrangements but also provides opportunities to learn about how to create your own paradise. Of particular interest to many are the scheduled events held throughout the year. These events range from holiday celebrations, where children can play games in attempt to learn about all types of flowers, to shows where individuals can compete for floral greatness.

CBG, according to the creators of the book, has taken an artistic approach in the overall creation of the gardens. As mentioned earlier, the book contains numerous photographs depicting the features of the grounds. This alone indicates that the book itself is a piece of artwork. Whether interested in CBG or not, the reader will enjoy flipping the pages and witnessing the beauty of the garden as if he or she were actually ambling among its flower laden paths. As can be said of many botanical gardens around the country, CBG appears to be one to definitely consider visiting if you're ever in the area.—*Christian A. Franklin, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

J. Bot. Res. Inst. Texas 2(2): 816. 2008

FOLIA TAXONOMICA 9. NEW SPECIES OF *PASSIFLORA* SUBG. *DECALOBA* (PASSIFLORACEAE) FROM NORTHERN SOUTH AMERICA

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ABSTRACT

Two new species of *Passiflora* subgenus *Decaloba* are described from northern South America: **P. angusta** and **P. rufa.** The status of *P. cryptopetala* Hoehne is discussed. The three species are referred to *Passiflora* supersection *Auriculata* J.M. MacDougal & Feuillet on the basis of plicate opercula, both petiolar and laminar nectaries, linear petals, attenuate coronal filaments, and transversely ridged seeds. A key to the species of the supersection is provided.

RÉSUMÉ

Deux espèces nouvelles de *Passiflora* sous-genre *Decaloba* du Nord de l'Amérique du Sud, **P. angusta** et **P. rufa,** sont décrites. Le statut de *P. cryptopetala* Hoehne est discuté. Les trois espèces sont placées dans *Passiflora* supersection *Auriculata* J.M. MacDougal & Feuillet au vu des opercules plissés, des glandes pétiolaires et laminaires, des pétales linéaires, des filaments de la couronne atténués et des graines striées transversalement. Une clé des espèces de la supersection est fournie.

Our work toward the treatment of the Passifloraceae for Flora of the Guianas (CF) and the study of subgenus *Decaloba* (DC.) Rchb. (JMM) brought attention to collections of *Passiflora* L. that proved to represent new species related to *Passiflora auriculata* Kunth, a tropical American species of subg. *Decaloba.* Many collections from the Guianas previously referred to *P. auriculata* represent *P. rufa* sp. nov., a species actually more common than *P. auriculata* in French Guiana. Other collections from Brazil and the Guianas belong in two other species, *P. angusta* sp. nov. from the Guayana shield and *P. cryptopetala* Hoehne from Amazonian Brazil. The three species and *P. auriculata* share several characters with *P. fanchonae* Feuillet (French Guiana), *P. ferruginea* Mast. (Peru), and *P. jatunsachensis* Schwerdtfeger (Ecuador) and are put in the same species group. Killip (1938) placed *P. auriculata* and *P. ferruginea* in series [Auriculatae] (invalid: no Latin description) at the base of his subgenus [Plectostemma] (invalid: includes the type of subg. *Decaloba*).

We have proposed supersection *Auriculata* J.M. MacDougal & Feuillet (Feuillet & MacDougal 1999, 2003; MacDougal & Feuillet 2004) for those species. *Passiflora* supersect. *Auriculata* belongs to subgenus *Decaloba*. The tip of growing stems is not cernuous. The laminar nectaries are scattered on the leaf blade and are not marginal or submarginal. Two paired petiolar nectaries are present and are conspicuously enlarged and elaborated laterally into flaps or ear-like appendages of the petiole, with the glandular area facing downward. The flowers have reduced linear petals, attenuate coronal filaments, and a plicate operculum. The seeds are transversely grooved.

The combination of laminar leaf nectaries position, a plicate operculum, and grooved seeds clearly places supersection *Auriculata* in *Passiflora* subg. *Decaloba*. In this subgenus, supersect. *Auriculata* is basal among the advanced groups that have lost the rpoC1 intron (Hansen et al. 2006). It still has petiolar nectaries like supersect. *Cieca* (Medik.) J.M. MacDougal & Feuillet or supersect. *Bryonioides* (Harms) J.M. MacDougal & Feuillet, yet is advanced in having nonmarginal laminar nectaries and grooved seeds like supersect. *Decaloba* (DC.) J.M. MacDougal & Feuillet.

An interesting natural history note (L. Gilbert, per. comm.): Gilbert (University of Texas at Austin) has "grown *P. rufa* since 1990 or so, prior to" the present "recognition of its status." He has "also grown *P. jatunsachensis* for at least that long," as well as "*P. auriculata* from Brazil, Panama, and Costa Rica. Quite often,

J. Bot. Res. Inst. Texas 2(2): 817 – 824. 2008

large plants of all these clade members will mass flower in the same few-day window even if in different greenhouses. It is as if there are ancestral clock genes shared by all of them that are independent of latitude of the source populations." One of us (JMM) observed the same phenomenon in the greenhouses at MO in the 1990s and that stimulated our interest in this group. It is possible that the plants are responding similarly to an environmental trigger instead of a clock. It would be interesting to check if *P. fanchonae*, another mass flowering species of this group in cultivation, follows the same pattern and synchronicity.

KEY TO THE SPECIES OF SUPERSECTION *AURICULATA*

1. Petiolar nectaries abaxial on appendages continuous with and proximal to the leaf blade (Guianas) **P. fanchonae**
1. Petiolar nectaries abaxial on appendages clearly separate from the leaf blade.
  2. Leaf blades glabrescent or with microscopic trichomes beneath (wide Neotropical distribution) **P. auriculata**
  2. Leaf blades pubescent beneath.
    3. Leaf blades at least 3 times as long as wide sparingly hairy above, shortly hairy beneath (Guianas, Venezuela) **P. angusta**
    3. Leaf blades usually much less than twice as long as wide or abundantly and obviously hairy.
      4. Leaf blades broadly ovate or sub-orbicular, 3–8 × 3.5–7.5 cm, shortly and densely hyaline puberulent on both sides (Amazonian Brazil) **P. cryptopetala**
      4. Leaf blades broadly ovate to narrow ovate, 8–25 × 5–15 cm, indumentum colored and obvious, hirsute above and thick velvety beneath.
        5. Vegetative parts with yellow trichomes; leaf blades elliptic, usually more than twice as long as wide (Napo, Ecuador) **P. jatunsachensis**
        5. Vegetative parts with rufous trichomes; leaf blades ovate to broadly ovate, usually once to twice as long as wide.
          6. Stem angular; bracts setaceous, 1–2 mm long; petals greenish (San Martin, Peru) **P. ferruginea**
          6. Stem terete; bracts narrowly triangular, 2.5 mm long; petals white (Guianas, NE Amazonian Brazil) **P. rufa**

Passiflora angusta Feuillet & J.M. MacDougal, sp. nov. (**Fig. 1 B, F, H; 2 A–C**). Type: GUYANA. Cuyuni-Mazaruni: Utshe River Falls, 5°44'N, 61°08'W, 900–975 m, 24 May 1990, fl., *T. McDowell & D. Gopaul 2834* (holotype: BRG; isotypes: AAU, B, COL, F, MO, NY, TEX, U, US).

Species haec ad *Passiflora* supersect. *Auriculata* pertinens; ab aliis speciebus foliis angustis, oblongis, laminis 3plo longioribus quam latioribus distincta; ab P. auriculata laminis foliorum infra dense pubescentibus distincta.

Herb climbing with tendrils, growing on shrubs. Stems subterete, weakly subangular, drying somewhat striate and sometimes almost glaucous, with short pubescence, apex of growing stem straight. Tendrils weak, short-pubescent. Stipules persistent, narrow-triangular, slightly curved, 0.7–1 mm long, apex acute, margin entire, pubescent. Petiole 5–20 mm long, cylindrical to obscurely canaliculate, pubescent, 2 glands under paired appendages, each appendage lateral, about 1/3 from the base of the petiole, saucer-shape, oval, with a central gland, ring glabrous, about as wide as the gland, ca. 1.7 × 1.1 mm; blade chartaceous to coriaceous, rigid, unlobed, narrow-oblong to narrow elliptic, or lanceolate to rarely obscurely 3-lobed and narrowly ovate, (3–)7–10 × 1–3(–3.5) cm, apex acute to slightly obtuse, base obtuse or rounded to slightly cordate, margin entire, recurved, adaxially shiny, with scattered, short, stiff hair on the veins, abaxially dull, with short, stiff hair, with (1–)2–6(–10) laminar glands, not visible adaxially on dry material, round, with a swollen circular rim, venation pinnate, raised on both surfaces, usually the proximal vein on each side longer but not reaching the margin, 3–5 main veins on each side. Inflorescences 2-flowered, axillary; peduncle lacking; bract near the 2 bracteoles, similar to them; pedicels, 10–15 mm long, joint 1–1.5 mm below the flower, shortly and densely pubescent; bract and bracteoles scattered in the basal 1/3 of the pedicel, persistent, triangular to triangular lanceolate, 1–1.4 mm long, apex acute, margin entire, shortly and densely pubescent. Flowers about 1.5 cm in diameter, yellowish green or yellow-white or green or green-white, fragrant (*Maguire 43838*); hypanthium saucer-shape, short-pubescent; sepals green outside, white to yellowish green inside, narrow triangular, 1.3–1.5 × 0.3–0.4 cm at base, apex acute to blunt in the same flower, margin entire, short-pubescent outside, densely pubescent in the basal 1/3 inside spreading; petals white,

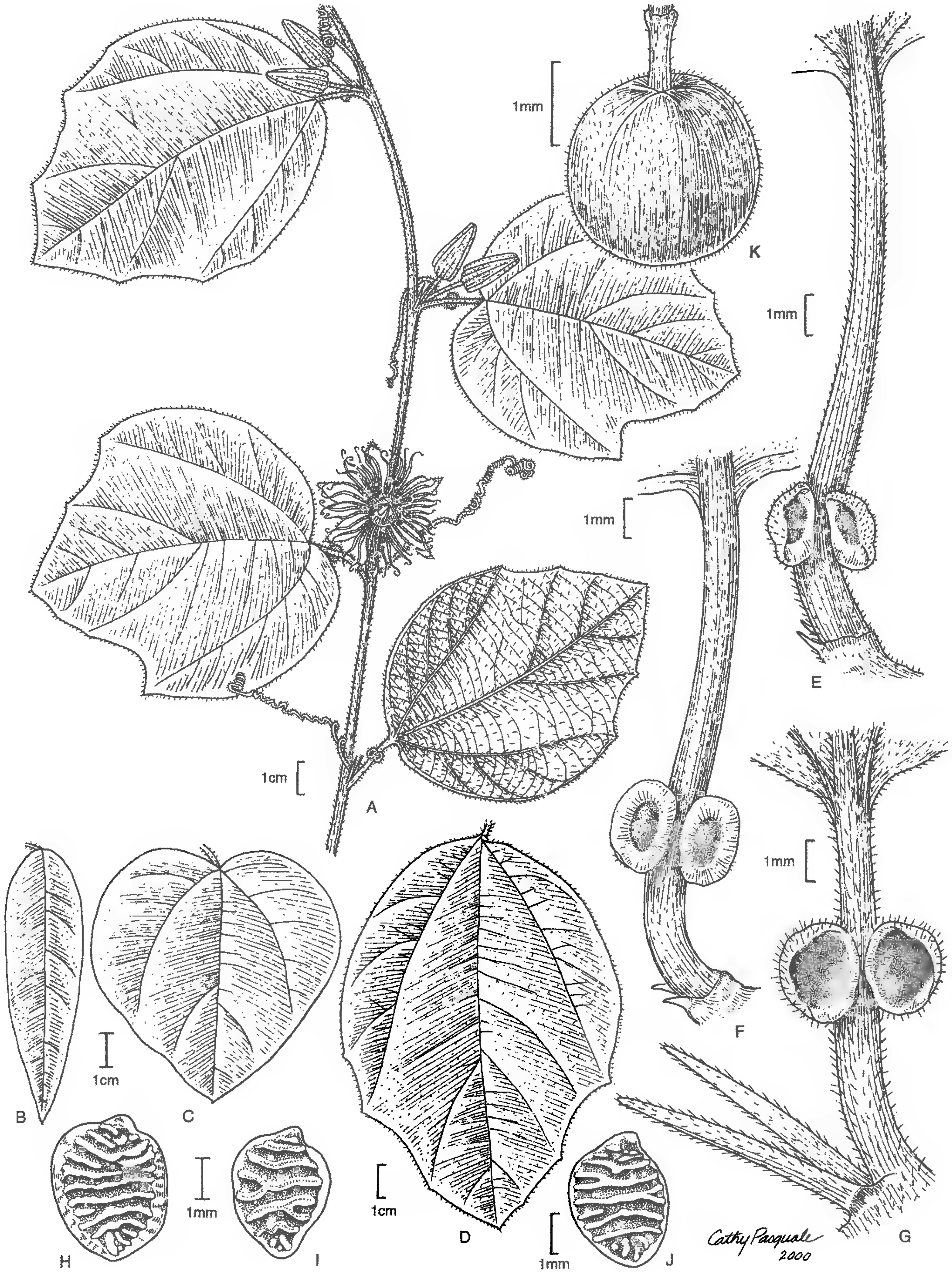
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Fig. 1. *Passiflora rufa*: **A.** Flowering stem; **D.** Leaf blade; **G.** Petiole; **J.** Seed; **K.** fruit. *Passiflora angusta*: **B.** Leaf blade; **F.** Petiole; **H.** Seed. *Passiflora cryptopetala*: **C.** Leaf blade; **E.** Petiole; Seed.—A, D. *Feuillet 4711* (holotype: US); B. *Maguire et al. 43838* (NY); C, E. *Gentry 13058* (MO); F, H. *McDowell & Gopaul 2690* (US); G. *Cremers 6905* (US); I. *Rodrigues & Chagas 12752* (INPA); J. *Cremers 6944* (US); K. *Grenand & Prévost 2047* (CAY).

linear, ½ to ¾ as long as the sepals, very thin, apex aristate, margin entire, glabrous on both surfaces, spreading; corona with 2 rows of filaments, outer row 1–1.5 cm long, widened and flattened at base, curly and attenuate near apex, purplish at base, light green or greenish yellow above, glabrous, inner row 2–5 mm long, capitate, glabrous; operculum membranous, plicate, glabrous; nectar ring not raised, densely and minutely papillose; limen annular, not raised, loosely papillose; androgynophore conical at base, then terete, ca. 0.5 cm long, glabrous; stamen at the base of the ovary, green, filaments narrow, slightly flattened, 0.7–0.8 cm long, glabrous, anthers dorsifixed, oblong, 3 × 0.7 mm; ovary globose, ca. 2 × 1.5 mm, densely covered with short thick hair, styles pale yellow, ca. 5 mm long, glabrous, stigmas swollen, facing outward, ca. 1 mm in diameter. Fruits globose, about 1.2–1.5 cm in diameter, green or purplish black, short appressed-pubescent, indehiscent; seeds black, ovate, axis slightly curved, flattened, about 3.5 × 3 mm, with 6–10 main transversal ridges.

The flowers are described on labels as being yellowish green (*Henkel 1034*), yellow-white (*McDowell 3081*), green (*Maguire 43838*), greenish (*Steyermark 117272*), or green-white (*McDowell 2744, 2834; Kral 72111*). The corona is said to be purple at base and green distally (*Henkel 1034*), olive-green at base (*Maguire 43838*), lavender (*Steyermark 117816*), or purple (*McDowell 2834*). Most collectors have noted the fruits to be green, these sometimes with mature-looking black seeds, but the fruits apparently continue to mature until they are blackish (*Gentry 10570*) or blackish purple (*Benítez 5200*).

Ecology and distribution.—*Passiflora angusta* is an herbaceous climber that crawls on shrubs and small trees in savannahs and savannah-forest ecotones. It is known from Venezuela (Bolívar), western Guyana, and Brazil (Roraima), between (270–)460 and 1300 m.

Etymology.—The epithet *angusta*, Latin for "narrow," refers to the narrow leaf blades compared to those of *P. auriculata*.

PARATYPES. **VENEZUELA. Bolívar:** Mun. Gran Sabana, desde Santa Elena en el Km 284, 900 m, 8 May 1995, fr., *C. Benítez & W. D'Arcy 5200* (MO); Mun. Rau'l Leoni, Pierdra Pintada, area de Pequenna Minería Aza Karón, 270 m, 06°19'11"N, 63°28'00"W, 23 May 1992, *W. Diaz 843* (MO); Mun. Gran Sabana, 4.2 km NE de Uriman, 400 m, 05°24'N, 62°42'W, Mar 1986, *A. Fernández 2456* (MO); Río Aponguao 2, near bridge over river, km 151–152 S of El Dorado, 1200 m, 16 Mar 1974, *A. Gentry et al. 10532* (MO); 133 km S of El Dorado, 1300 m, 16 Mar 1974, fr., *A. Gentry et al. 10570* (MO); Dist. Roscio, 3 km S of El Paují, 1050 m, 4°30'N, 61°35'W, 19 Oct 1985, *B. Holst & R.L. Liesner 2356* (MO); 7 km E of Kavanayen, 1100 m, 16 Dec 1984, fl., *R. Kral 72111* (MO); Río Las Ahallas, 17 km E of El Pauji, 4°30'N, 61°30'W, 850 m, 30 Oct 1985, fl., *R.L. Liesner 19182* (MO), 1 Nov 1985, fl., *R.L. Liesner 19273* (MO), 1 Nov 1985, fr., *R.L. Liesner 19277* (MO); 0–3 km W of El Polo, NW of El Pauji, 4°30'N, 61°40'W, 650–800 m, *R.L. Liesner 19588* (MO); 0–6 km SE of El Pauji, 4°30'N, 61°35'W, 800–900 m, 9 Nov 1985, *R.L. Liesner 19778* (MO); 0–2 km W of El Pauji, 4°30'N, 61°35'W, 850–900 m, 10 Nov 1985, fl., *R.L. Liesner 19823* (MO); Dist. Piar, Río Aparamán, affluent of Río Acanán near Yuiray-merü rapids, 1.5 km S of SW corner of Amaruay-tepui, 500 m, 05°54'N, 62°15'W, *R.L. Liesner & B. Holst 20203* (MO); Dist. Piar, Rio Acanán, EDELCA Campo Carrao, 5 km NW of NW corner of Amaruay-tepui, 5°57'N, 62°17'W, 470 m, 3 May 1986, *R.L. Liesner & B. Holst 20540* (MO); 10 km of Karaurin Tepui, 5°19'N, 61°03'W, 900–1000 m, 24 Apr 1988, fr., *R.L. Liesner 23757* (MO); 5 km S of San Ignacio de Yuruani, 4°59'N, 61°10'W, 850 m, 9 May 1988 fl., *R.L. Liesner 24402* (MO, US); Cumbre de cerro Guaiquinima, entre el afluente del rio Carapo (1 km rio arriba del Salto Szczerbanari) y los peñascos al S del rio, 730–900 m, 05°44'4"N, 63°41'8"W, 24 May 1978, fl., *J. Steyermark et al. 117272* (MO); Quebrada El Cajón, Puente Luis Raúl Vásquez Z., 26.5 km al E de Icabarú, 750 m, 04°25'N, 61°32'W, 18 Dec 1978, fl., *J. Steyermark et al. 117816* (MO); Distr. Roscio, 7.5 km NE de Santa Elena de Uairén, 880 m, 4°40'N, 61°04'W, 3 Dec 1982, *J. Steyermark & R.L. Liesner 127570* (MO). **GUYANA. Cuyuni-Mazaruni:** Imbaimadai Savannahs, near mouth of the Partang River, 460 m, 14 Jun 1960, fl., *B. Maguire, S.S. Tillett & C.L. Tillett 43838* (NY); Top of Warama Tipu, small Mt. across Karamang River, N to Paruima village, 5°50'N, 61°04'W, 530–610 m, 20 May 1990, fr., *T. McDowell & D. Gopaul 2690* (BRG, NY, US); Utshe camp, 0.3 km N of Utshe River, 5°45'N, 61°08'W, 975 m, *T. McDowell & D. Gopaul 2744* (MO); 7 km N of Paruima village, near Mt. Waleliwatipu, 5°54'N, 61°02'W, 980–1060 m, 30 May 1990, fr., *T. McDowell & D. Hughs 2982* (BRG, US); Macaw creek to Holitipu Camps, hillside of Kartabo Mt., 6°00'N, 61°05'W, 580–1100 m, 4 Jun 1990, fl. & fr., *T. McDowell & D. Gopaul 3081* (BRG, US). **Potaro-Siparuni:** Pakaraima Mts., south rim of summit ridge, Cipo Mtn., 2–4 km from Cipo Creek, 4°54'N, 60°05'W, 1250 m, 28 Jan 1993, fl., *T.W. Henkel, M. Chin & W. Ryan 1034* (BRG, U, US); Pakaraima Mts., headwaters of the Mazaruni R., W of Imbaimadai, 5°43'N, 60°20'W, 21 Jun 1986, fr., *J.J. Pipoly 7944* (BRG, CAY, NY, US). **BRAZIL. Roraima:** 1300 m, Dec 1909, fl., *E. Ule 8665* (B?, K, MG, U, US).

Passiflora cryptopetala Hoehne, Comm. Linh. Telegr. Matto Grosso Ann. 5: Bot. pt. 5:76; pl. 112. 1915. (**Fig. 1 C, E, I; 2 D-F**). LECTOTYPE: BRAZIL: near the trijunction point between Amazonas, Pará & Mato Grosso, near San Manuel, Feb 1912, fl., *Hoehne Comissão Rondon 5178* (HOLOTYPE: R; photograph in Hoehne 1915).

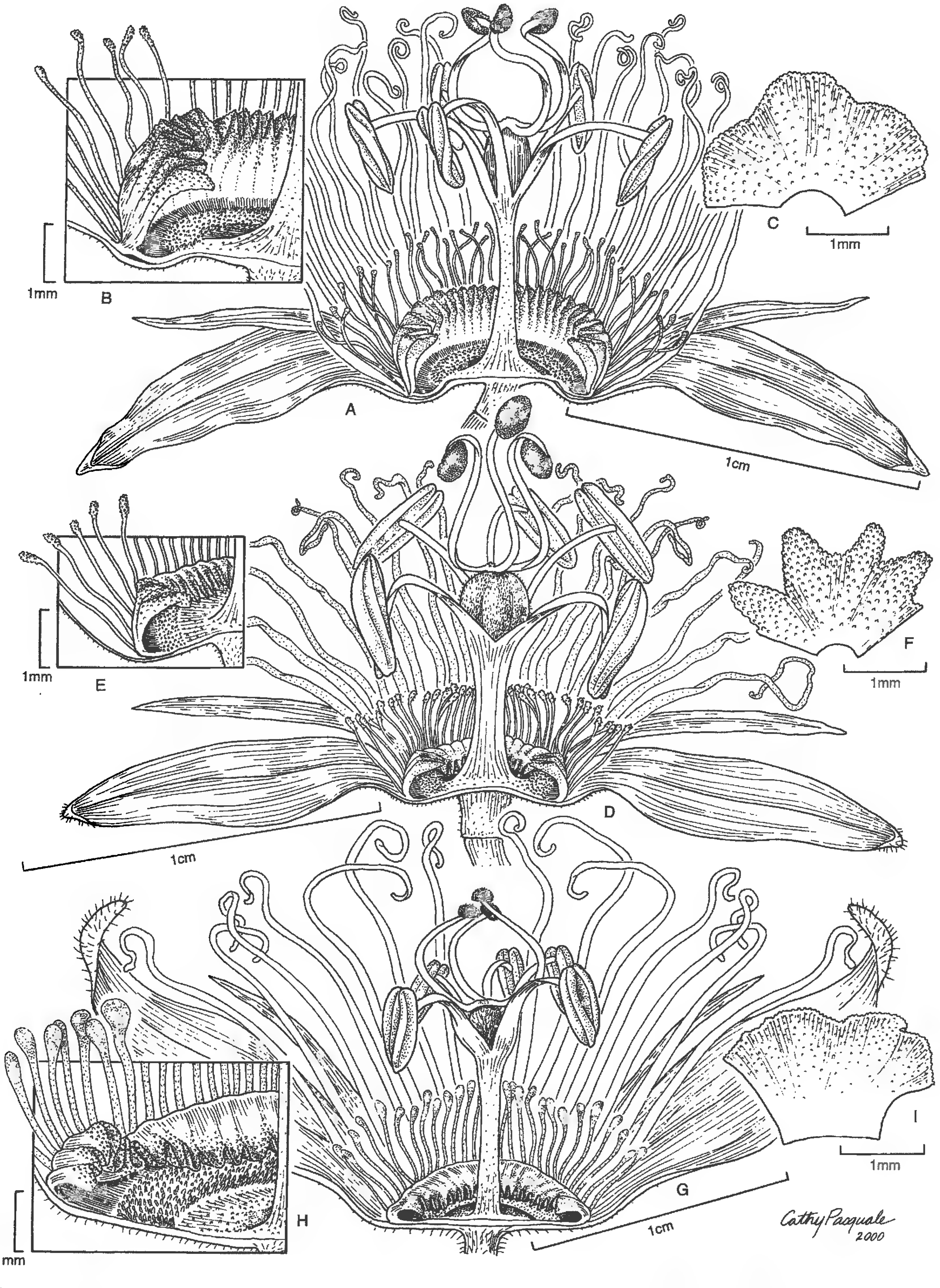

Fig. 2. *Passiflora angusta*: **A.** Flower (longitudinal cut); **B.** Detail showing the corona, the plicate operculum, and the floral cup; **C.** Operculum unfolded (partial); *Passiflora cryptopetala*: **D.** Flower (longitudinal cut); **E.** Detail showing the corona, the plicate operculum, and the floral cup; **F.** Operculum unfolded (partial). *Passiflora rufa*: **G.** Flower (longitudinal cut); **H.** Detail showing the corona, the plicate operculum, and the floral cup; **I.** Operculum unfolded (partial).—A–C. *McDowell & Gopaul 3081* (US); D–F. *Gentry 13058* (MO); G–I. *Feuillet 4711* (holotype: US)

Herbaceous to suffruticose climber with tendrils. Stems terete, minutely puberulent, apex of growing stem straight, striate. Tendrils few. Stipules scale-like, triangular 0.2–0.3 mm long, pubescent. Leaves alternate; petiole 1.5–2 cm long, pubescent, 2 glands under paired appendages, each appendage lateral between middle and ca. 1/4 from the base of the petiole; blade wide-ovate or sub-orbicular, 3–8 × 3.5–7.5 cm, apex obtuse or rounded or abruptly and shortly acuminate, base slightly cordate or round, margin entire or with 2 obscure teeth or mucros, shortly and densely puberulent on both sides, with 1–3 glands between the midrib and the main lateral vein on each side, occasionally between the lateral vein and the margin. Inflorescences 2-flowered, axillary; peduncle lacking; bract near the 2 bracteoles, similar to them; pedicels erect, recurved when bearing the fruit, about as long as the petiole, pubescent, joint 1.5–2 mm below the flower; bracteoles near the base of the peduncle, triangular, ca. 1 mm long, pubescent. Flowers white, 2.5–3 cm in diameter; hypanthium saucer-shaped, outside minutely puberulent, yellow-orange inside; sepals lanceolate, 0.7–1 cm long, white adaxially, outside minutely puberulent; petals linear, shorter and much narrower than the sepals; corona in 2 rows, filaments of the outside row spreading, purplish at base, ligulate, filiform at apex, those of the inner row oblique or erect, filiform, capitate; operculum membranous, plicate, erect somewhat curved inward in apical half; androgynophore 3–4 mm long, glabrous; stamen anthers linear-oblong, slightly purplish at margin; ovary ovoid, pubescent. Fruit globose, ca. 2 cm in diameter, with short indumentum; seeds ovate, axis slightly curved, flattened, ca. 3 × 2 mm, with 5–6 main transversal ridges.

Killip (1938) offered a broad concept of *P. auriculata* Kunth and placed *P. cryptopetala* Hoehne in its synonymy. We consider the plant to deserve recognition at the rank of species. The original description of *P. cryptopetala* was illustrated by a photograph of a herbarium specimen. The above description was drawn from Hoehne's original description and the specimens cited below. The dried fruits of *Rodrigues & J. Chagas 4482* are dark colored, suggesting they might have been dark purple or black when ripe like in most species in this group.

Ecology and distribution.—Amazonian Brazil, on river banks and non-flooded moist forests.

Vernacular name.—Maracujá bravo (Brazilian Portuguese: *Chagas s.n.* and *Rodrigues & Chagas 4482*).

Additional specimens. **BRAZIL. Amazonas:** Fazenda Dimona, 72 km N of Manaus, 2°19'S, 60°05'W, 50–125 m, 15 Feb 1989, *M. Pacheco, E. Palheta & S. de Souza 202* (INPA, NY); Manaus, estrada do Igarapé do Passarinho, 8 May 1962, fr., *W. Rodrigues & J. Chagas 4482* (INPA); Manaus, estrada da Forquilha, marg. Igarapé da Cacheira Alta, 13 Aug 1956, *J. Chagas s.n. (INPA 4083)* (INPA); Manaus-Itacoatiara Rd, km 84, 3 Dec 1974, fl., *A. Gentry 13058* (INPA, MO). **Pará & Mato Grosso:** near the trijunction point between Amazonas, Pará & Mato Grosso, near San Manuel, Feb 1912, fl. & fr., *Hoehne Comissão Rondon 5176* (R), fl., *Hoehne Comissão Rondon 5177* (R). **Pará:** Alto Tapajós, Vila Nova, perto da Cachoeira do Chacorão, 21 Jan 1952, fr., *J.M. Pires 3986* (US).

Passiflora rufa Feuillet & J.M. MacDougal, sp. nov. (**Fig. 1 A, D, G, J, K; 2 G–I**). TYPE: FRENCH GUIANA. MONTAGNES DE KAW: between Roura and Camp Caïman, ca. 10 km from Roura, 12 Mar 1988, fl., *C. Feuillet 4711* (HOLOTYPE: US; ISOTYPES: CAY, P, U).

Species haec ad *Passiflora* supersect. *Auriculata* pertinens; a *P. ferruginea* laminis foliorum margine non crassi-obtusidentatis ad apicem nervorum principalium, ab aliis speciebus foliis rufo-pubescentibus distincta.

Herbaceous to woody climber with tendrils, to 15–20 m high, mostly rufous-tomentose. Stems terete, striate when dry, green to rufous, tomentose, apex of growing stem straight. Tendrils strong, rufous, tomentose. Stipules usually persistent, narrow triangular, 5–7 mm long, acute, margin entire, rufous-tomentose. Petiole reddish brown, canaliculate, 1.5–3.5 cm long, tomentose, 2 glands under paired appendages, each appendage lateral, about 1/3–1/2 from the base of the petiole, 1.5–2 × 2–3 mm, saucer-shape, rufous, oval, with a central gland, greenish black; blade becoming chartaceous, ovate, 9–25 × 5–15 cm, apex acute, base cordate, obscurely 3–5-lobed or margin entire, with a few laminar glands on each side in the sector defined by the midrib and the 2 basal veins, round, with a raised rim, ca. 1 mm in diameter, adaxially dark green, stiff hirsute (usually appressed when dry), abaxially pale green, rufous-tomentose, venation 3(–5)-palmate, rufous beneath, raised on both surfaces, camptodromous, 1–3 main veins on each side, secondary venation scalariform. Inflorescences 2-flowered, axillary; peduncle lacking; bract near the 2 bracteoles, similar to them; pedicels 2, spreading, 1.5 cm long, rufous, rufous-tomentose, joint 1 mm below the flower; bract and

2 bracteoles scattered in the basal 1/5, persistent, narrow triangular, 2.5 mm long, apex acute, margin entire, rufous tomentose. Flowers facing upward, yellowish white, fragrant; hypanthium saucer-shaped, ca. 0.8 cm in diameter, yellowish green to rufous green and rufous pubescent outside, yellowish green inside; sepals triangular, 1.5–2 × 0.6–0.9 cm long, apex rounded with a subapical short awn, yellowish green to rufous green and rufous pubescent outside, whitish and glabrous inside, spreading; petals linear, 7–8 × ca. 1 mm, thin, apex acute, whitish transparent when dry, glabrous, spreading; corona with 2 rows of filaments, outer row 1.5–2 cm long, laterally flattened, spreading, green at base and green spotted with violet brown in the middle, the apical 1/3 filiform, yellow, contorted, inner row capitate, ca. 3 mm long, pale yellow-green, white at apex; operculum plicate, erect, ca. 2 mm tall, whitish; nectary ring slightly swollen, pale yellowish green; limen not raised, whitish; androgynophore terete, 0.6–0.7 cm long, greenish to green spotted with violet; stamen just below the ovary, filaments flat, narrow, ca. 0.6 cm long, greenish white, anthers dorsifixed, elliptic, 4 × 1.5 mm, yellowish; ovary globose, 2–2.2 × 1.8–2 mm, pale green, densely pubescent, 0.6 cm long, greenish white, glabrous, stigmas ca. 1 mm in diameter, pale yellow. Fruits pendent, globose, 1.5–2 cm in diameter, black, hirsute, trichomes white, pulp white, indehiscent; seeds ovate, axis slightly curved, flattened, about 3 × 2.5 mm, with 5–6 main transversal ridges, black.

The new species resembles *P. ferruginea* from Peru by its leaf size, shape, and rufous pubescence. *Passiflora rufa* has 2–6 lateral veins reaching the margin, forming small teeth (Fig.1 A & D). In *P. ferruginea* the main veins reaching the margin form a hardened mucro, an uncommon character in the genus.

Passiflora auriculata does not have the rufous pubescence of *P. rufa* and is mostly glabrous or glabrescent with microscopic trichomes. In French Guiana, the ripe fruits of *P. auriculata* are yellow to orange, those of *P. rufa* are dark violet to black, and those of *P. fanchonae* cherry to dark red.

Distribution and ecology.—*Passiflora rufa* has been collected on the Guiana shield and the Amazonian basin. The species of supersection *Auriculata* in French Guiana colonize different niches: *Passiflora rufa* grows on slopes or well drained areas, on lateritic soil or forest humus, at the edge of forest, *P. fanchonae* has been collected near temporary pools or drainage ditches in forested areas, on red soil or forest humus, and *P. auriculata* is found at the edge of permanent pools or creeks, generally in open vegetation, mostly on sand.

Etymology.—The new species is named *rufa* for the rufous trichomes that cover the vegetative parts of the plant.

Paratypes. **BRAZIL. Amazonas:** Manaus, Estrada do Paredão, 8 Apr 1943, fl., *A. Ducke 1213* (MG leaf fragm.); Pará: Munic. Paragominas, 17 km S of Ligação along Belém – Brasília Highway, near km marker 1509, 250 m, 2 Mar 1980, fr., *T. Plowman, G. Davidse, N.A. Rosa, C.S. Rosário & M.R. dos Santos 9440* (MG). **GUYANA. Barima-Waini:** Aranka R. head, settlement W of Baramita, 7°25'N, 60°32'W, 107 m, 9 Apr 1991, fr., *T. McDowell 4327* (BRG, US). **SURINAM. Sipaliwini:** near riv. Itany, 3 km upward from Cr. Koulé-Koulé, 25 Jul 1985, st., *C. Feuillet 2803* (CAY, US). **FRENCH GUIANA:** Approuague riv. basin, Road Cayenne – Régina, km 50, 11 Jun 1984, fl., *C. Feuillet 1402* (CAY, P); km 48, 4 May 1979, fr., *M.F. Prévost 575* (CAY(2), US); Route de Bélizon, 11 km off road Cayenne – Régina, 52°20'W, 4°25'N, 19 Feb 1988, st., *C. Feuillet 4577* (US); Route de Bélizon, 17 km off road Cayenne – Régina, 52°20'W, 4°25'N, 1 Jun 1988, *C. Feuillet 9857* (CAY, US); Station des Nouragues, 27 Feb 1987, seedlings, *M.F. Prévost 2216* (CAY); Comté riv. basin, between Route Nationale 2 and Cacao, 52°25'W, 4°33'N, 8 Jul 2005, fl., *M.F. Prévost 4876* (CAY, K, MO, P, US), Montagne Cacao, 17 Jan 1983, fl., *C. Feuillet 545* (CAY, P); 52°27'W, 4°33'N, 1 Jun 1988, fr., *C. Feuillet 9848* (CAY, US); 3–4 km from Cacao, N slope, 52°30'W, 4°35'N, 25 Mar 1985, fr., *L.E. Skog & C. Feuillet 5683* (CAY). **Montagne de Kaw:** between Roura and Camp Caïman, 15 Jun 1979, fr., *G. Cremers 5780* (CAY(3), US); near Camp Caïman, ca. 22 km from Roura, 23 Nov 1980, fl., *G. Cremers 6905* (CAY, US); 9 Jan 1981, fl., *C. Feuillet 178* (CAY); western slope, 27 Dec 1980, fl. & fr., *G. Cremers 6944* (CAY(2), P, US); 17 Apr 1985, fr., *C. Feuillet 2098* (CAY, P); 18 Apr 1985, st., *C. Feuillet 2105* (CAY, P); 8 km from Roura, 52°9'12"W, 4°33'N, 26 Nov 1985, fr., *C. Feuillet 2884* (CAY, MO, P, US) & seedlings, *2884A* (CAY); summital plateau, 28 Feb 1988, *C. Feuillet 4672* (CAY); Oyapock riv. basin, near Cr. Patawa, near St.-Georges-de-l'Oyapock, 17 Apr 1981, fr., *P. Grenand & M.F. Prévost 2047* (CAY, US); 16 May 1983, fr., *M.F. Prévost 1378* (CAY(2)).

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FOLIA TAXONOMICA 10. NEW SPECIES OF *NAUTILOCALYX* (GESNERIACEAE: EPISCIEAE) FROM THE VENEZUELAN GUAYANA

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ABSTRACT

Seven species of *Nautilocalyx* are described from the Venezuelan Guayana; **Nautilocalyx crenatus, N. orinocensis,** and **N. ruber** from the state of Amazonas; **N. paujiensis, N. pusillus, N. roseus,** and **N. vestitus** from the state of Bolívar.

RÉSUMÉ

Sept espèces de *Nautilocalyx* sont décrites de Guyane Vénézuélienne; **Nautilocalyx crenatus, N. orinocensis** et **N. ruber** de l'état d'Amazonas; **N. paujiensis, N. pusillus, N. roseus** et **N. vestitus** de l'état de Bolívar.

The numerous collections made in the last 50 years in Bolívar and Amazonas states of Venezuela uncovered several new species. In the Gesneriaceae, the new species have a clear affinity for the mountains, the bases of the tepuis, and the headwaters of nearby rivers. Of course, these locations reflect the nature of the collecting efforts that took place during the last decades. Since the middle of the 20th century, there was a resurgence of interest for the Gesneriaceae of the Guiana Shield (Leeuwenberg 1958; Feuillet & Steyermark 1999; Skog & Feuillet 2008). At the middle of the 20th century, most species currently included in *Nautilocalyx* Linden ex Hanst. were included in *Episcia* Mast. along with many species now placed in *Paradrymonia* Hanst. *Nautilocalyx* was greatly augmented with the redefinition of *Episcia* (Wiehler 1973, 1978). As a group of 57 species currently accepted (including the six described below), it is different from *Episcia* by the lack of stolons (Wiehler 1973) and seems closer to *Chrysothemis* Decne. than to *Episcia* as shown by recent DNA analyses which included one species of *Nautilocalyx* and of *Paradrymonia* (Smith 2000; Zimmer et al. 2002; Clark & Zimmer 2003). All but Smith (2000) placed the *Chrysothemis / Nautilocalyx* clade close to *Paradrymonia*. Clark et al. (2006) sequenced 155 species of the tribe Episcieae, including seven species of *Nautilocalyx* and 13 of *Paradrymonia*. Their analysis showed *Chrysothemis* nested in *Nautilocalyx*, itself nested in *Paradrymonia*. Both *Nautilocalyx* and *Paradrymonia* are in great need of morphological and molecular studies to identify monophyletic groups and of revisions to reflect the resulting clades.

1.—New pink- or red-flowered species of *Nautilocalyx*

Nautilocalyx crenatus Feuillet, sp. nov. (**Fig. 1**). TYPE: VENEZUELA. AMAZONAS: Cerro Yapacana, alrededores del campamento a lo largo del río en las faldas en la parte suroeste, 3°45'N, 66°45'W, 825 m, 4 May 1970 (fl), *J.A. Steyermark & G. Bunting 103068* (HOLOTYPE: US; ISOTYPES: NY, VEN).

Nautilocalyci cataractarum affinis. Planta parviore; sepalis lanceolatis, integris; corollae rubrae, tubo bis longiore; glande non lobata; ovario bis parviore differt.

Saxicolous herb; leaves clustered at apex of short stem; stem densely long-hairy in young parts. Leaves opposite, equal in a pair: petiole lacking to 1 cm long, densely villous, trichomes 3.5–4.5 mm long; blade elliptic to oblanceolate, 2.5–8 × 1.2–2.7 cm, base attenuate to decurrent, apex obtuse to slightly acute, margin crenate to mostly bi-crenate, laxly ciliate, adaxially rugose, deep green or bronze, and laxly pilose with trichomes 1–1.5 mm long, abaxially lavender or purplish, densely antrorsely pilose on main veins, less so on veinlets, each side of the midrib 6–7 strongly ascending main lateral veins anastomosing 3–5 mm from the margin.

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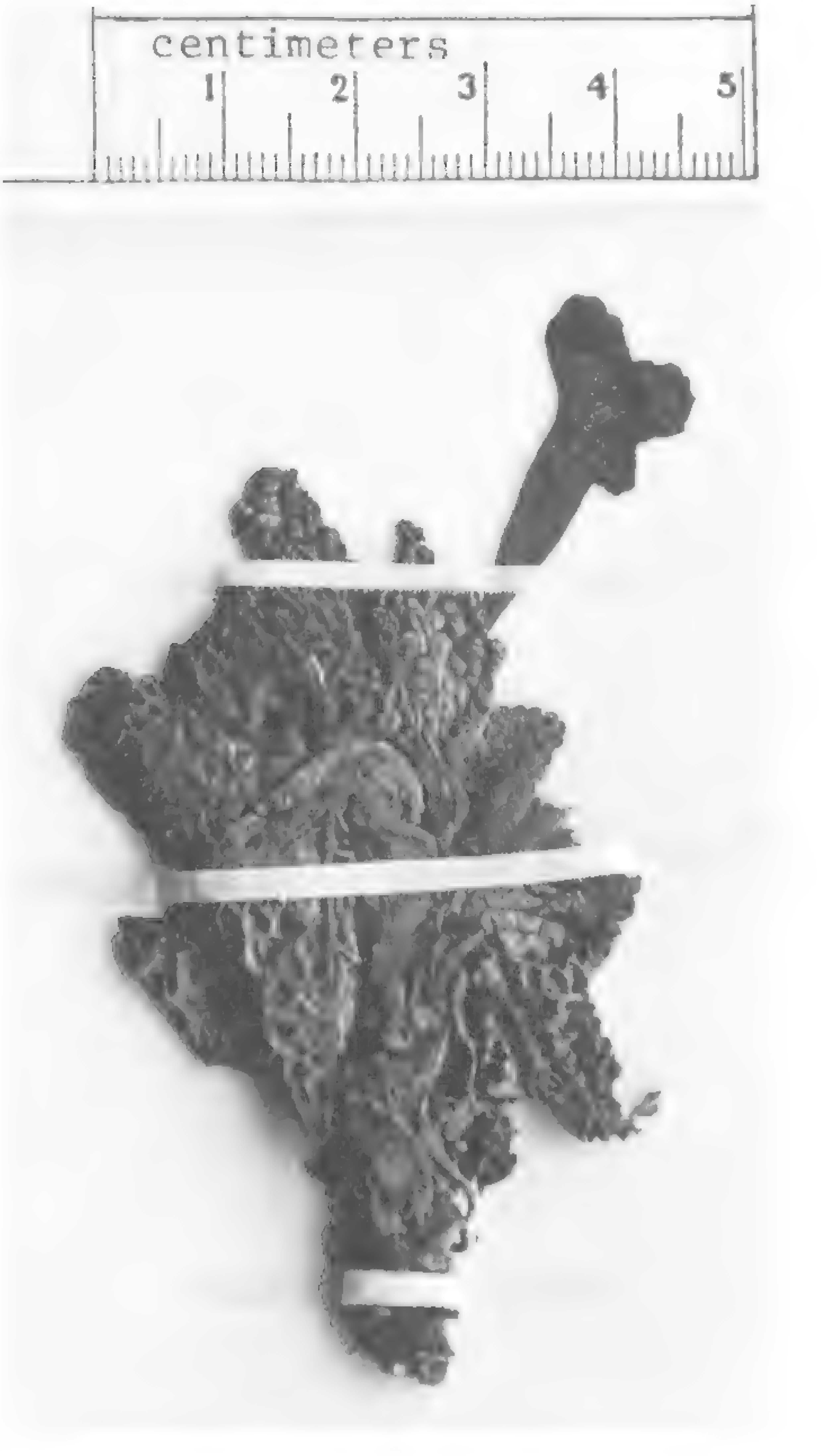

Fig. 1. ***Nautilocalyx crenatus*, photograph by C. Feuillet of *Steyermark & Bunting 103180* (paratype: US)**

Inflorescence a reduced pair-flowered cyme, axillary, appearing fasciculate, with several flowers, pedicels 1.5–1.7 cm long densely appressed-villous. Flowers: sepals free, oblanceolate to oblong, slightly unequal, the larger 4–6 × 2 mm, the smaller 3–4 × 1–1.5 mm, margin 0–3-crenate on each side near apex, densely villous outside, sparsely pilose near apex within; corolla red, posture oblique to nearly transverse in the calyx, spur narrow-oblong, 5 × 1–1.5 mm, glabrous, tube 2.3–3 cm long, 0.6 cm wide at throat, appressed-villous outside, lobes suborbicular, 7 × 7 mm, sparsely appressed-pilose outside, glabrous within; stamens with anthers suborbicular-oblong, 1.2 × 0.9 mm; nectary gland dorsal, ovate, 1 mm long, apex obtuse to rounded, glabrous; ovary long-ovoid, 2 × 1 mm, densely sericeous, style glabrous. Fruit not seen.

Distribution.—*Nautilocalyx crenatus* is known from Cerro Yapacana (Amazonas, Venezuela) where it grows in crevices and on wet rocks, 800–1200 m. It was flowering in May.

Nautilocalyx crenatus resembles *N. cataractarum* Wiehler, from the state of Bolívar, in habitat, habit, and leaf texture. It differs from *N. cataractarum* by an overall smaller plant habit and has flowers with sepals entire at margin, a truly red corolla with a longer and nearly straight tube, an unlobed dorsal nectary gland, and an ovary half the size. *Nautilocalyx crenatus* was *Nautilocalyx* "sp. F" in Feuillet and Steyermark (1999).

Etymology.—The epithet *crenatus* refers to the crenate or bi-crenate margin of the leaf blades.

PARATYPE: **VENEZUELA. Amazonas:** Cerro Yapacana, en la cumbre, 3°45'N, 66°45'W, 1000–1200 m, 5–7 May 1970 (fl), *J.A. Steyermark & G. Bunting 103180* (US, VEN).

Nautilocalyx paujiensis Feuillet, sp. nov. (**Fig. 2**). TYPE: VENEZUELA. BOLÍVAR: 17 km E of El Paují by road and 64 km W of Santa Elena by road, 4 km N of highway, Río Las Ahallas, ca. 4°30'N, 61°30'W, 850 m, 28 Oct 1985 (fl), *R.L. Liesner 19044* (HOLOTYPE: US; ISOTYPES: MO, VEN).

Nautilocalyci kohlerioidi affinis; tota planta per pilos rubros vestita, lamina basi obtusa vel acuta, floribus fasciculatis, sepalis bis brevioris, oblanceolatis, corollae tubo longi-hirsuto differt.

Terrestrial herb, decumbent, 25–45 cm tall; stem hirsute, trichomes 3–4 mm long, red, internodes 5–12 cm long. Leaves opposite and decussate, equal in a pair: petiole 2–5 cm long, hirsute, trichomes red; blade elliptic to oblanceolate, 7–13 × 3.5–5.5 cm, base asymmetrical, obtuse to acute, often rounded at very base, apex obtuse, sometimes shortly and widely acuminate, margin crenate to bicrenate with sinuses always acute and teeth rarely so, adaxially appressed-pubescent, surface flat, abaxially pubescent-hirsute on veins, on both sides trichomes of dried specimens hyaline, 7–10 main veins on each side of the midrib. Inflorescence a reduced pair-flowered cyme, axillary, appearing fasciculate, with 3–10 flowers; pedicels 1–4 cm long, hirsute, trichomes red. Flowers: sepals free, oblong to ovate, 6–8 × 2–3 mm, with few teeth toward apex, hirsute on both sides, trichomes red; corolla posture slightly oblique in the calyx, red, hirsute outside, trichomes red, 3–4 mm long, basal gibbosity rounded, 2.5 mm long, 2–2.5 mm wide, tube 2–2.5 cm long, wider 2/3 from base, somewhat narrowed at the throat, lobes suborbicular, 5 × 5 mm, margin entire, glabrous within, outside hirsute at base, androecium and gynoecium not seen (flowers glued). Young fruit ovoid, nearly as long as the reddish calyx, hirsute.

Distribution.—*Nautilocalyx paujiensis* is known only from the type specimen collected 17 km east of El Paují (Bolívar, Venezuela) were it was growing on mossy rocks and cliffs at 850 m elevation. It was collected with a few flowers and young fruits in October.

Nautilocalyx paujiensis resembles *N. kohlerioides* (Leeuwenb.) Wiehler, from the basin of the Oyapock river in Amapá (Brazil) and French Guiana. It differs from *N. kohlerioides* by the red indumentum, the leaf blades obtuse to acute at the base, the fasciculate flowers with oblanceolate sepals half the size and by the hirsute indumentum on the corolla tube. *Nautilocalyx paujiensis* was *Nautilocalyx* "sp. D" in Feuillet and Steyermark (1999).

Etymology.—The new species is named for the community of El Paují near which the species was discovered.

Nautilocalyx pusillus Feuillet, sp. nov. (**Fig. 3**). TYPE: VENEZUELA. BOLÍVAR: near El Paují, Río Cabass, waterfall, 4°30'N, 61°35'W, 800–900 m, 3 Nov 1985 (fl), *R.L. Liesner 19429* (HOLOTYPE: US; ISOTYPES: MO, VEN).

Nautilocalyci porphyrotrichi affinis; lamina floreque parvioris, corollae non gibbosa, glande non lobata, ovario ter breviore differt.

Saxicolous herb; whole plant hirsute or appressed-pubescent except the stamens and the style. Leaves opposite, equal or unequal in a pair: petiole lacking or to 3 cm long, densely strigose; blade linear-oblanceolate to narrowly oblanceolate, 4.5–15 × 0.7–3.5 cm, base decurrent, apex acute to acuminate, margin minutely serrate to bi-serrate on the apical 3/4, adaxially gray appressed-pubescent, abaxially hirsute on veins, with 5–6 main lateral veins on each side of the midrib, strongly ascending, ending near the margin but not clearly

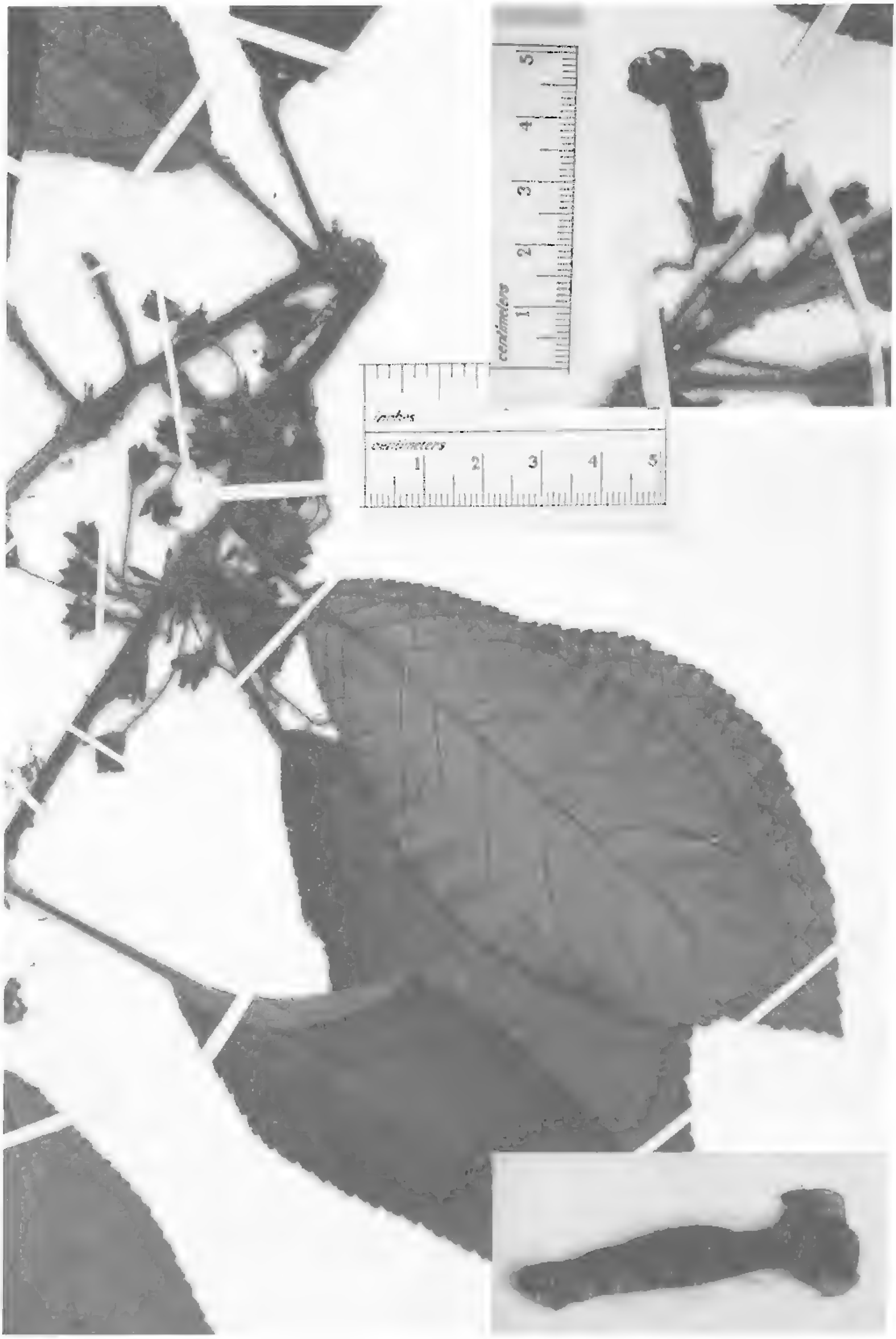
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Fig. 2. *Nautilocalyx paujiensis*, photographs by C. Feuillet of *Liesner 19044* (main, holotype: US; top insert, isotype: VEN; bottom insert holotype, corolla total length 3.2 cm for scale)

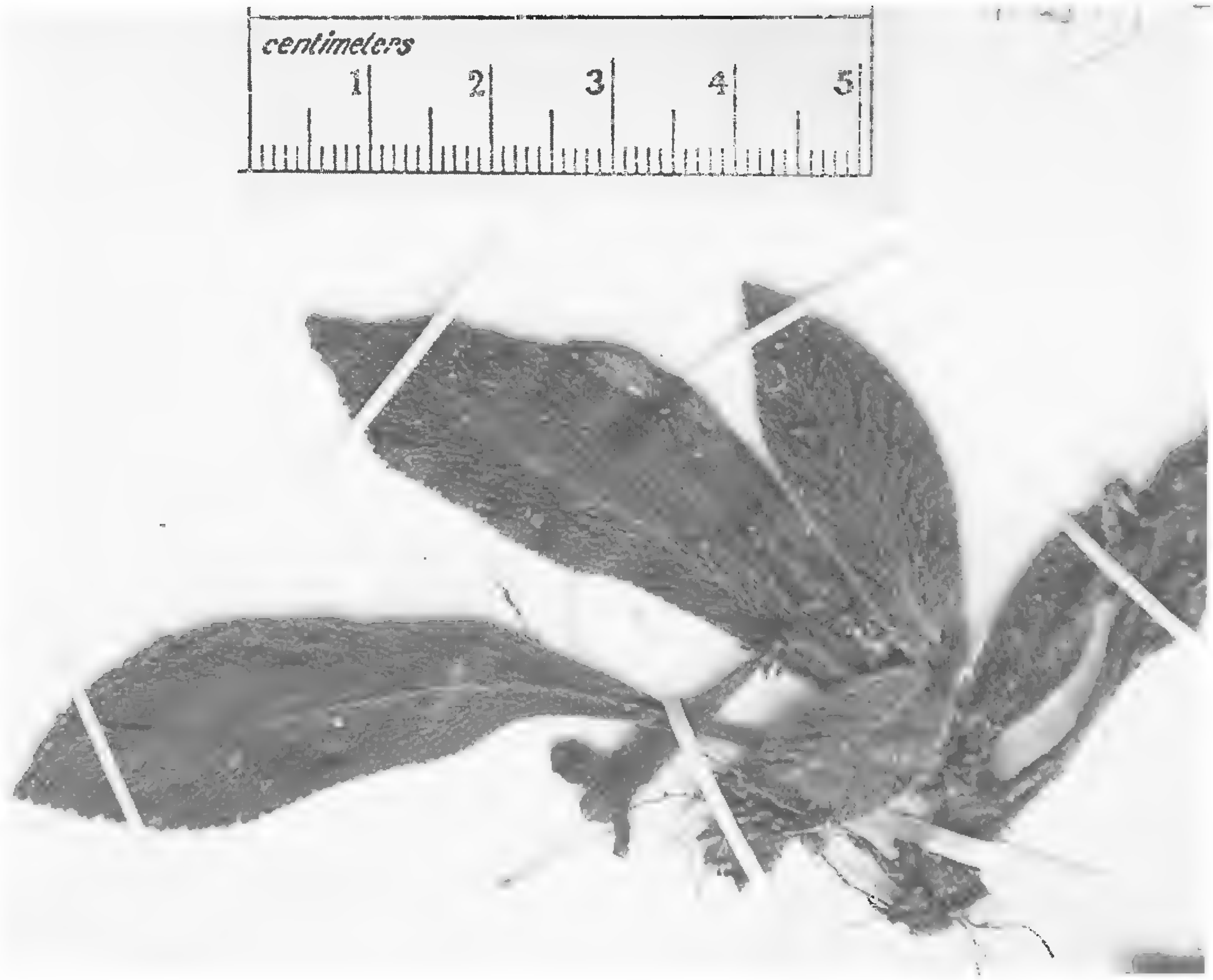

Fig. 3. ***Nautilocalyx pusillus*, photograph by C. Feuillet of *Liesner 19429* (holotype: US)**

anastomosing. Inflorescence a reduced pair-flowered cyme, axillary, appearing fasciculate, 1–2-flowered, pedicels 13–20 mm long, densely villous with purplish red spreading-ascending, 1.5 mm long trichomes. Flowers: calyx with lobes free or nearly so, connate for 0–2 mm, lobes subequal, narrowly to linear lanceolate, 4–5 × 0.7–1 mm, acute at apex, densely hirsutulous outside, glabrous except near apex within; corolla posture straight in the calyx, scarlet, not gibbous at base, tube 1.5–2 cm long, densely hirsute outside except in the calyx, glabrous within, lobes unequal, upper 2 rounded, 2 × 2.5 mm, lower 3 ovate–oblong, 4 × 2.5 mm; stamens 4: filaments 8 mm long, inserted on the corolla 6 mm from the base, glabrous, anthers coherent in 2 pairs, sagittate, 1.2 × 1 mm; gland oblong-lanceolate, 1.2 mm long, sulcate in upper half; ovary ovoid, 1.5 × 1 mm, sericeous, style 9 mm long, glabrous, stigma bilobed, lobes short, eventually growing to 1 mm long. Fruit not seen.

Distribution.—*Nautilocalyx pusillus* grows on boulders or in bluff crevices, 500–900 m, near El Paují and Icabarú (Bolívar, Venezuela). It was flowering October to December.

Nautilocalyx pusillus resembles *N. porphyrotrichus* (Leeuwenb.) Wiehler, from Guyana and Venezuela. It differs from *N. porphyrotrichus* by the smaller size of the leaves and the flowers, especially its ovary 1/3 the size, and by the lack of a basal gibbosity ("spur"). *Nautilocalyx pusillus* resembles also young *N. arenarius* L.E. Skog & Steyerm., but this latter species has cup-shaped calyces with short lobes and white corollas twice the size. *Nautilocalyx pusillus* was *Nautilocalyx* "sp. G" in Feuillet and Steyermark (1999).

Etymology.—The epithet *pusillus* refers to the small size of the plant.

Paratypes: **VENEZUELA. Bolívar:** 4 km of El Paují, Río Chaberú, 750–900 m, 4°30'N, 61°36'W, 12 Nov 1985 (fl), *R.L. Liesner 19904* (US); 5 km S of El Paují, "El Abismo", Río Samay, affluent of Río Icabarú, 4°23'N, 61°38'W, 520 m, 23 Oct 1985 (fl), *R.L. Liesner & B.K. Holst 18978* (MO, US, VEN); a lo largo de la quebrada El Cajón, Puente Luís Raúl Vasquez Z., 26.5 km al este de Icabarú, 4°25'N, 61°32'W, 750 m, 18 Dec 1978 (fl), *J.A. Steyermark, V. Carreño Espinosa & G. C. K. Dunsterville & E. Dunsterville 117834* (SEL, VEN).

Nautilocalyx roseus Feuillet, sp. nov. (**Fig. 4**). Type: VENEZUELA. Bolívar: N side of Auyan tepui, along banks of Quebrada Honda, Mar 1969 (fl), *G.C.K. Dunsterville & E. Dunsterville s.n.* (holotype: VEN).

Nautilocalici cataractarum affinis; internodo longiore, pedicellis longioribus, calycis lobis angustioribus, corollae tubo breviore, cylindraceo, antheris discretis, stylo breviore differt.

Terrestrial herb, decumbent; stems at least 10 cm long, densely appressed-pubescent, internodes 4–5 cm long. Leaves opposite, decussate, equal or subequal in a pair: petiole densely villous, 1.5–2.5 cm long; blade elliptic-oblanceolate or broadly oblanceolate, 10.5–11.5 × 3.8–4.5 cm, base cuneate, apex acute, margin densely serrulate except at base, adaxially densely appressed villous, abaxially appressed villosulous mainly on the veins, 6–7 main veins on each side of the midrib, ascending, anastomosing near the margin. Inflorescence a reduced pair-flowered cyme, axillary, appearing fasciculate, up to 12-flowered; pedicels slender, 15–20 mm long, densely villosulous, trichomes 1–1.5 mm long. Flowers small: calyx fused at base, cup 1 mm long, 3 mm wide, lobes linear-lanceolate, 5 × 0.7–0.8 mm, apex acute with a sclerified, cylindrical, blunt tip, densely villosulous outside, trichomes 0.7–1.5 mm long, villosulous inside in apical half, glabrous in basal half; corolla tubular, tube "pale gray rose", 12 mm long, 3.5 mm wide for most of the length, slightly dorsally gibbous making the base rounded and moving the insertion on the receptacle in a ventral position, glabrous ventrally in the basal 4 mm, otherwise villous, lobes suborbicular, "deep rose", the two dorsal ones 4.5 × 3 mm, rounded, glabrous on both sides, the three others rounded, 3 × 3 mm, without pubescent in basal part, otherwise glabrous, within glabrous; stamens four, included, inserted 3 mm from the base of the corolla, filaments base lanceolate, 2 × 0.8 mm, sparsely ciliolate, apex filamentose, 5–6 mm long, spirally twisted, glabrous, anthers not coherent, bilobed in basal half, 1 × 0.8 mm; nectary gland dorsal, about 1 × 0.5 mm, bilobed, glabrous; ovary narrowly ovoid, 2 × 1–1.3 mm, acute, densely sericeous, style glabrous, 6.5 mm long, stigma bilobed. Fruits not seen.

Distribution.—Known only from the type collection from Quebrada Honda, north of Auyan Tepui, about 10 km west of Angel Falls in Parque Nacional Canaima. It was in bloom in March.

Nautilocalyx roseus was annotated by H. Wiehler as *Nautilocalyx sp. aff. melittifolius* (L.) Wiehler and later by J.A. Steyermark as an elongated-stemmed form of the rosulate *N. cataractarum* Wiehler. In spite of some similarities and of the geographical proximity of the type localities, *N. roseus* can be separated from *N. cataractarum* (type from the base of Angel Falls) by a series of characters. The leaf margin of *N. roseus* is serrate versus crenate and the pedicels are 15–20 vs. 5–10 mm long. The calyx lobes are fused into a cup at base vs. free and their width is 0.7–0.8 vs. 1.2 mm. The corolla tube is cylindrical vs. ventricose and the lobes are 3 mm wide and unequal (2 dorsal longer) vs. 5–7 mm wide and equal (or the 2 dorsal slightly shorter). In the stamens, the anthers are free vs. coherent in a group of four and the filaments are spirally twisted vs. not twisted. Finally the style is 6.5 vs. 9–10 mm long. *Nautilocalyx melittifolius* from the Lesser Antilles is clearly different with pedunculate inflorescences, calyx lobes 3–7 mm wide, and ovary 4–5 mm long.

Etymology.—Named *roseus* for the color "rose" (according to the specimen-label) of the corolla.

Nautilocalyx ruber Feuillet, sp. nov. (**Fig. 5**). Type: VENEZUELA. Amazonas: Dept. Atures, 4 km of Río Coro-Coro, W of Serranía de Yutajé, 9 km NW of settlement of Yutajé, along stream on plateau north of unnamed 1760 m peak, 5°41'N, 66°10'W, 1050–1300 m, 7 Mar 1987 (fl), *R.L. Liesner & B.K. Holst 21728* (holotype: US; isotype: MO, VEN).

Nautilocalyci maguirei affinis; lamina angusto-oblanceolata, parviore, petiolo multo beviore, sepalis oblanceolatis, intus glabris, corollae tubo breviore differt.

Terrestrial or saxicolous herb; stem pubescent to densely villous with 1–1.5 mm long spreading trichomes. Leaves opposite, unequal in a pair: petiole lacking or to 3 cm long, densely villous; blade oblanceolate, 6–17 × (1.5–)2–5.5 cm, base appearing decurrent but mostly long narrowly attenuate and asymmetrically

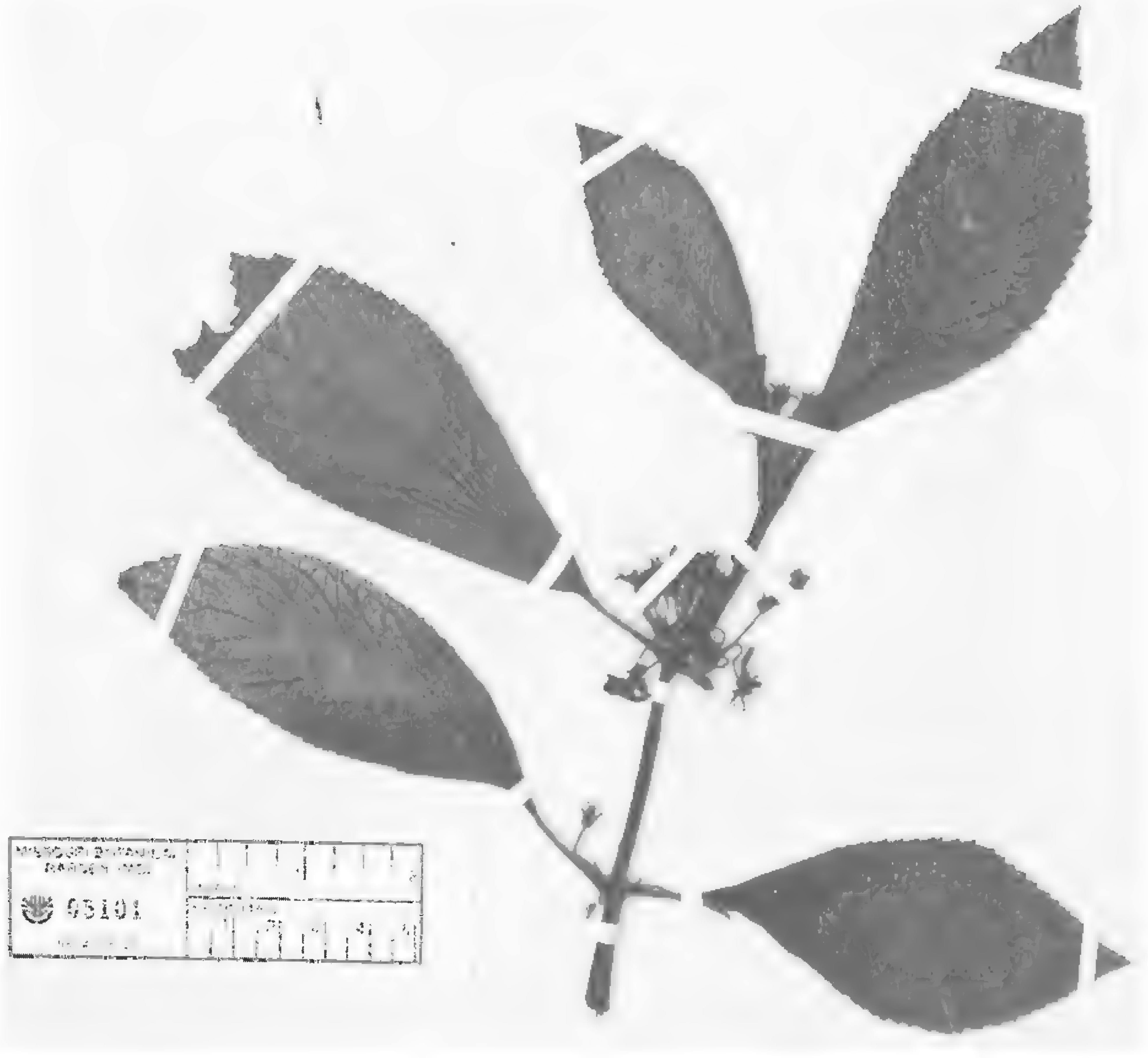

Fig. 4. ***Nautilocalyx roseus*, photograph by C. Feuillet of *Dunsterville & Dunsterville s.n.* (holotype: VEN)**

rounded at very base, apex rounded to acute, margin ciliate and wide crenate to bi-crenate, adaxially bullate, silvery around the midrib, with 2–3 mm long trichomes on top of the bullae, otherwise glabrous, abaxially conspicuously reticulate with areolae 2–4 mm diam., villosulous on the main vein, each side of the midrib with 8–13 main lateral veins anastomosing 3–5 mm from the margin. Inflorescence a reduced pair-flowered cyme, axillary, appearing fasciculate, pedicels slender, appressed-villous, 1.5–2 cm long. Flowers: sepals subequal, free, oblanceolate, 6–8 × 1.5–2 mm, sparsely to densely pilosulous outside, with 1–few teeth near apex and ciliate at margin, glabrous inside; corolla red to orange-red, tube 2.5–3.5 cm long, 3 mm wide at base, 6 mm at throat, sparsely puberulent outside, glabrous within except near throat where sparsely papillate, lobes 7 × 5 mm, the ventral one up to 9 × 6 mm, short appressed-pubescent outside; stamens: filaments broadened at base where minutely ciliate, otherwise glabrous, anthers broadly oblong, cordate at base, rounded at apex, 1.2 × 0.9 mm; nectary gland dorsal, 0.8–0.9 mm long and wide, obscurely 3 lobed at apex, sulcate near base; ovary ovoid, 3.5 × 1.5 mm, short sericeous, style glabrous, 2 cm long. Fruit (ripe?) ovoid, acute at apex, about 6 × 4 mm, pilosulous at apex.

Distribution.—*Nautilocalyx ruber* has been collected on the Serranía de Yutajé and Cerro Sipapo (Amazonas, Venezuela) on stream banks or mossy rocks, 300–1500 m. It was flowering in December and February-March, and fruiting in December.

The leaves of *Nautilocalyx ruber* are distinctive from other congeners. Their texture is reminiscent of *N. maguirei* L.E. Skog & Steyerm. and of *N. pemphidius* L.E. Skog, but the blades are oblanceolate, long attenuate,

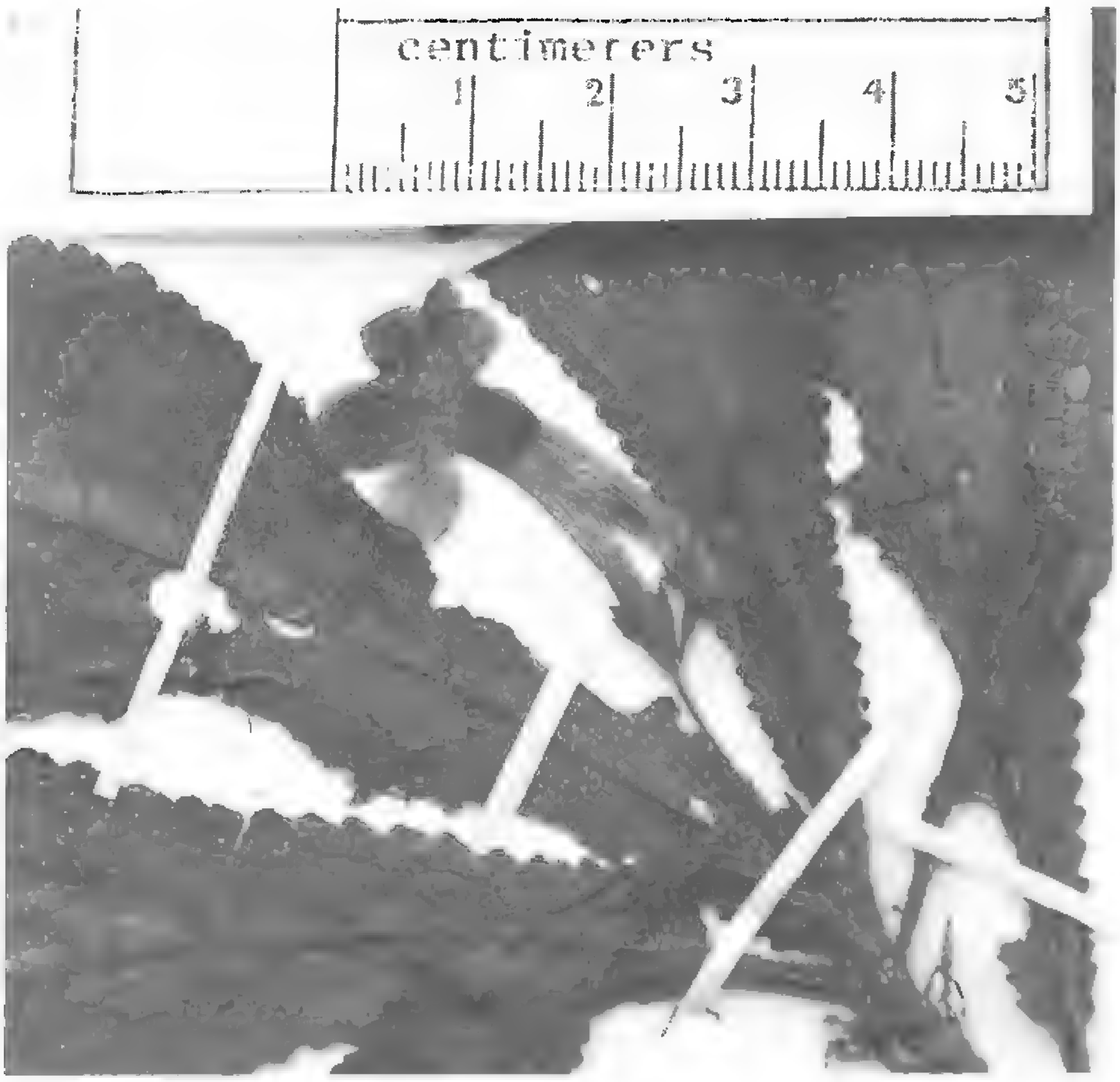

Fig. 5. ***Nautilocalyx ruber*, photograph by C. Feuillet of *Liesner & Holst 21708* (holotype: US, corolla total length 3.2 cm for scale)**

nearly decurrent to the petiole, but asymmetrically rounded at the narrow base. It differs from the white-flowered *N. pemphidius* by its much larger and orange-red corollas, and from the red-flowered *N. maguirei* by the shape and smaller size of the leaf blades, by the much shorter petioles, by the sepals oblanceolate and glabrous adaxially, and by the shorter corolla tube. *Nautilocalyx ruber* was *Nautilocalyx* "sp. E" in Feuillet and Steyermark (1999).

Etymology.—Named *ruber* for the red color of the corolla.

Paratypes: **VENEZUELA. Amazonas:** Dept. Atures, Río Coro-Coro, stream and slopes E of river, W of Serranía de Yutajé, 6 km N of settlement of Yutajé, 5°41'N, 66°07'W, 320 m, 21 Feb 1987 (fl), *R.L. Liesner & B.K. Holst 21300* (MO, US, VEN); Serranía de Yutajé, Caño Yutajé, 1500 m, 21 Feb 1953 (fl), *B. Maguire & C. K. Maguire 35368* (NY, US); Cerro Sipapo, between Phelps Camp and North Savanna, 1400 m, 17 Dec 1948 (fl & fr), *B. Maguire & L. Politi 27746* (NY, US, US).

Although the color of the corolla is not considered here as a proof of phylogenetic relationship, for practical reasons it might be useful to present the following key.

KEY TO THE PINK- OR RED-FLOWERED *NAUTILOCALYX* FROM THE VENEZUELAN GUAYANA

1. Leaf blade ovate or obovate ____ **N. chimantensis** L.E. Skog & Steyerm.
1. Leaf blade elliptic or oblanceolate.
  2. Leaf blade surface flat.
    3. Leaf blades 12–30 cm long; calyx lobes about 10 times as long as wide ____ **N. fasciculatus** L.E. Skog & Steyerm.
    3. Leaf blades 6–12 cm long; calyx lobes about 3–7 times as long as wide.
      4. Stem appressed-pubescent; calyx lobes linear-lanceolate, forming a short cup at the base ____ **N. roseus** Feuillet
      4. Stem hirsute; calyx lobes oblong to ovate, free ____ **N. paujiensis** Feuillet
  2. Leaf blade bullate.
    5. Leaf blade oblanceolate.
      6. Corolla tube up to 2.5 cm long ____ **N. maguirei** L.E. Skog & Steyerm.

    6. Corolla tube more than 2.5 cm long **N. ruber** Feuillet
  5. Leaf blade elliptic.
    7. Petiole up to 1.5 cm long.
      8. Corolla tube about 1.5 cm long **N. cataractarum** Wiehler
      8. Corolla tube about 2 cm long **N. crenatus** Feuillet
    7. Petiole more than 2 cm long.
      9. Calyx lobes entire; corolla tube 2–3 cm long **N. pusillus** Feuillet
      9. Calyx lobes dentate; corolla tube 3–5 cm long **N. porphyrotrichus** (Leeuwenb.) Wiehler

2.—New white-flowered species of *Nautilocalyx*

Nautilocalyx orinocensis Feuillet, sp. nov. (**Fig. 6**). TYPE: VENEZUELA. AMAZONAS: Upper Orinoco river, Sierra Guaharibo, near Raudal de los Guaharibos, slopes of "Mt. Rimbaud," light growth near the top, 30 Jul 1951 (fl), *L. Croizat 429* (HOLOTYPE: NY; photograph MO, negative # 05102).

Nautilocalyci bryogeton affinis; floribus latioribus, sepalo bis longiore, corollae tubo ter longiore differt.

Terrestrial or saxicolous (?) herb; shortly pubescent throughout; internodes very short, leaves remaining only on the young growth. Leaves opposite, equal in a pair: petiole 4–6 cm long, densely villous; blade obovate, 7–9 × 3–5 cm, base narrowed and then rounded, slightly emarginate and asymmetric, apex broadly rounded to obtuse, margin obscurely crenate, adaxially densely and minutely appressed-pubescent, abaxially densely appressed pubescent on main veins, loosely so on the tertiary veins and glabrescent between the veins, 4–6 main veins on each side of the midrib. Inflorescence a reduced pair-flowered cyme, axillary, appearing fasciculate, 2–4-flowered; pedicels 8–10 mm long, densely villous. Flowers: sepals narrowly lanceolate, 11 × 1.5 mm, densely villous on both sides, ciliate at margin; corolla white, spur narrow, 2 × 1 mm, tube more than 3 cm long, densely villous outside (only corolla damaged, partly hidden by leaves, glued on the herbarium sheet), glabrous within with papillae in apical part (in bud), lobes glabrous on both sides (in bud); stamens recoiled in the basal third of the tube; nectary gland dorsal, ligulate-oblong, 1 × 0.6 mm; ovary narrowly ovoid, 2 mm long, densely hirsutulous, style more than 1.5 cm long. Fruit subglobose, 5 × 5 mm, densely pubescent.

Distribution.—*Nautilocalyx orinocensis* was discovered near the top of a slope on "Mt. Rimbaud," Sierra Guaharibo (Amazonas, Venezuela), in "light growth," near the Upper Orinoco. It was flowering and fruiting in July.

Nautilocalyx orinocensis resembles *bryogeton* (Leeuwenb.) Wiehler from Guyana. It differs from *N. bryogeton* by much larger flowers: sepals 11 × 1.5 mm (versus 4–6 × 1–1.5 mm), corolla tube, more than 3 cm long (versus 1.2 cm), ovary narrowly ovoid, 2 mm long (versus globose, 1 mm long). The two species are similar in their vegetative parts. *Nautilocalyx orinocensis* was *Nautilocalyx* "sp. B" in Feuillet and Steyermark (1999).

Etymology.—The new species is named *orinocensis* after the Orinoco river.

Nautilocalyx vestitus Feuillet, sp. nov. (**Fig. 7**). TYPE: VENEZUELA. BOLÍVAR: Cumbre del Cerro Guaiquinima, a lo largo del affluente del Río Carapo, 1 km río arriba del Salto Szczerbanari, 5°44'N, 63°41'W, 730–750 m, 23–24 May 1978 (fl), *J.A. Steyermark, P. Berry, G. C. K.Dunsterville & E. Dunsterville 117244* (HOLOTYPE: VEN).

Planta tota vestita, praeter supra nervos medios et laterales dense hirsuta, lamina serrata vel crenata, sepala angustato-lanceolata, corolla alba.

Saxicolous herb; stems covered with long brown trichomes. Leaves opposite, decussate, equal or subequal in a pair: petiole 1–2.5 cm long, covered with long brown trichomes; blade obovate, 3–7 × 2–3.5 cm, covered with long white trichomes, base acute to cuneate, apex rounded to obtuse, margin serrate-crenate, adaxially densely pilose except on main veins, abaxially densely pilose, main veins 6–8 on each side of the midrib. Inflorescence a reduced pair-flowered cyme, axillary, appearing fasciculate, 1–3-flowered; pedicels 4–5 mm long, covered partly by the indumentum of the stem, covered with short trichomes. Flowers: sepals linear-lanceolate, 6–7 × 1–2 mm, pale green, covered with long white trichomes, apex curved outward in bud; corolla white in young bud (according to the specimen-label). Fruit not seen.

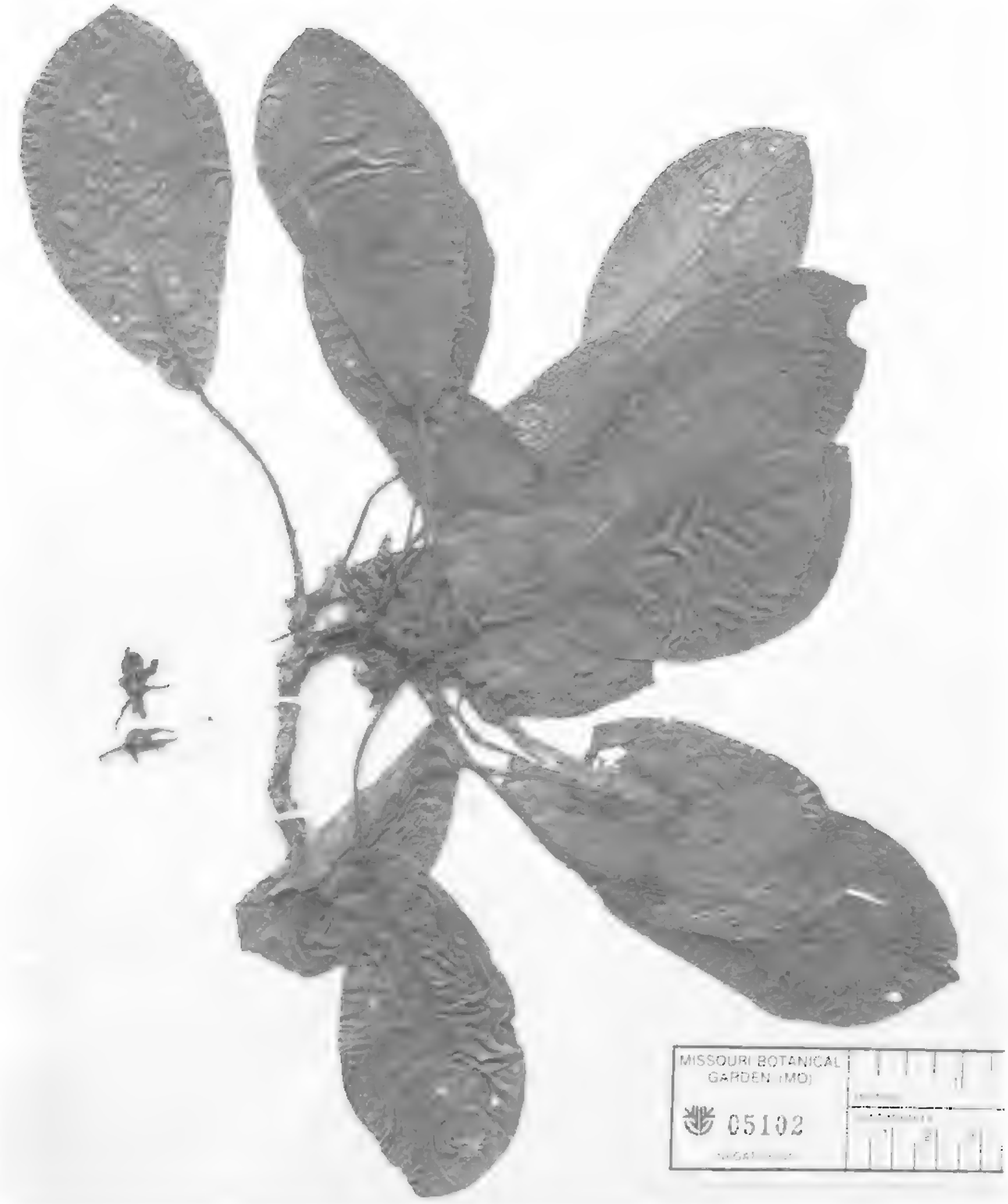

Fig. 6. ***Nautilocalyx orinocensis*, photograph by C. Feuillet of *Croizat 429* (holotype: NY)**

Distribution.—*Nautilocalyx vestitus* was found on the Cerro Guaiquinima (Bolívar) in Venezuela, on shaded bluffs of narrow rocky quebrada along a small stream, 730–750 m. It was in flower bud in May.

Nautilocalyx vestitus is unique among the *Nautilocalyx* species by its vegetative characters. It shares with *Episcia duidae* Feuillet, *E. rubra* Feuillet, and an undescribed *Paradrymonia*, from the state of Amazonas, a long and dense indumentum usually characteristic of plants able to survive exposed to strong winds. It will be

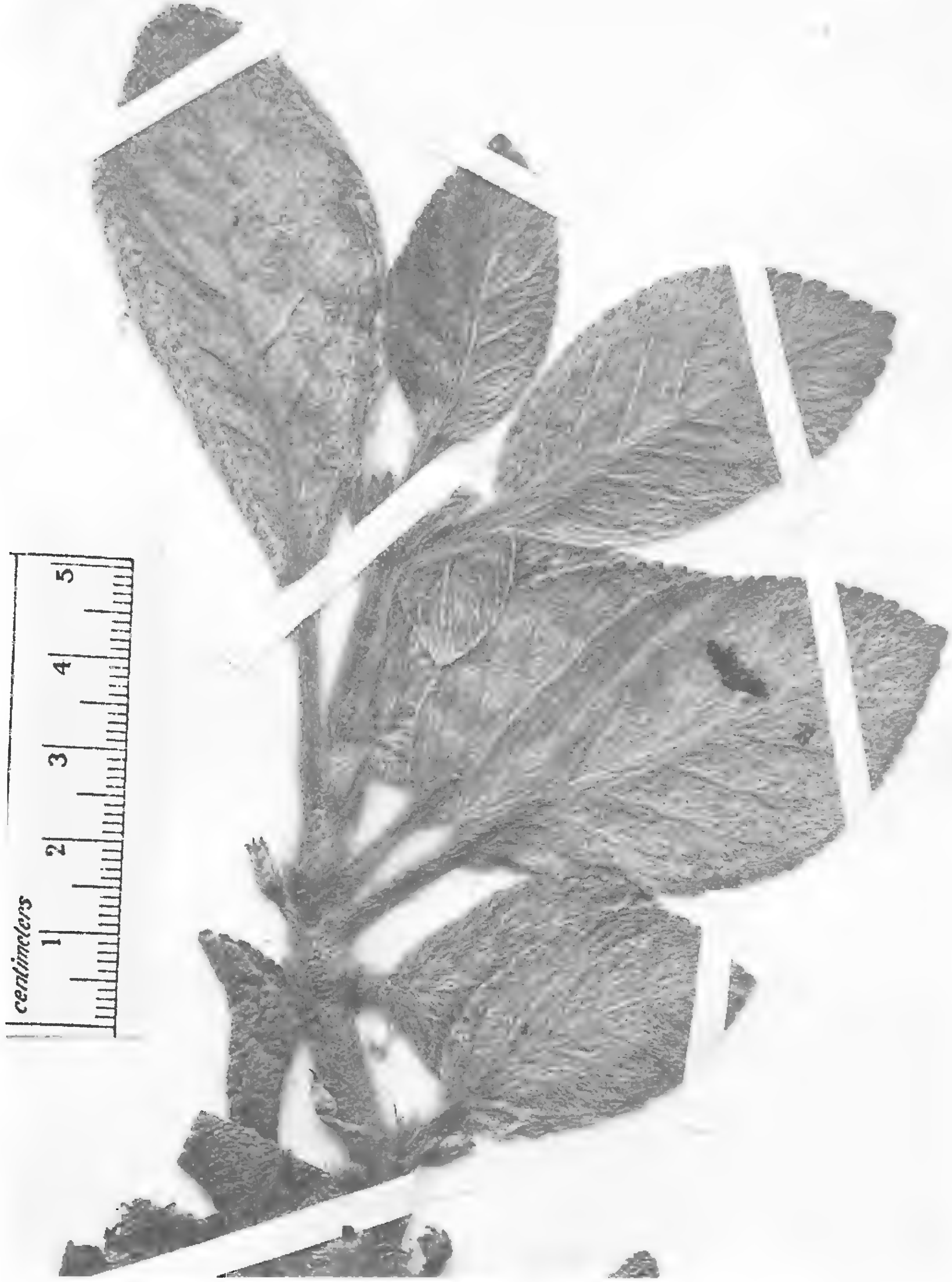
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Fig. 7. *Nautilocalyx vestitus*, photograph by C. Feuillet of *Steyermark et al. 117244* (holotype: VEN)

necessary to study an open flower to assess the relationships of *N. vestitus* with other species of *Nautilocalyx*. *Nautilocalyx vestitus* was *Nautilocalyx* "sp. A" in Feuillet and Steyermark (1999).

Etymology.—The epithet *vestitus* refers to the dense, brownish or white indumentum that covers the stems and leaves of the plant.

KEY TO THE WHITE- OR LAVENDER-BLUE-FLOWERED *NAUTILOCALYX* FROM THE VENEZUELAN GUAYANA

1. Leaf blade ovate or obovate.
  2. Leaf blade ovate **N. adenosiphon** (Leeuwenb.) Wiehler
  2. Leaf blade obovate.
    3. Lower surface of leaves with tertiary veins hidden by long hairs **N. vestitus** Feuillet
    3. Lower surface of leaves with tertiary veins obvious.
      4. Leaf blade narrowly rounded; corolla white **N. orinocensis** Feuillet
      4. Leaf blade widely rounded; corolla tube white, lobes lavender blue **N. cordatus** (Gleason) L.E. Skog
1. Leaf blade elliptic or oblanceolate.
  5. Leaf blade surface bullate.
    6. Leaf blade oblanceolate, margin large-crenate **N. pemphidius** L.E. Skog
    6. Leaf blade elliptic, margin short-crenate-serrate **N. resioides** (Leeuwenb.) Wiehler
  5. Leaf blade surface flat.
    7. Leaf blade not decurrent on the petiole **N. arenarius** L.E. Skog & Steyerm.
    7. Leaf blade decurrent on the petiole.
      8. Leaves and bracts reddish **N. punctatus** Wiehler
      8. Leaves and bracts green or whitish **N. pallidus** Sprague

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FOLIA TAXONOMICA 11.
CONSPECTUS OF *VARRONIA* (CORDIACEAE: BORAGINALES) IN THE GUIANA SHIELD WITH THREE NEW COMBINATIONS

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ABSTRACT

The conspectus lists the 17 taxa of newly resurrected *Varronia* P. Browne (Cordiaceae) present in the flora of the Guiana Shield or rejected. The synonymy and three new combinations are included: **Varronia bullata** subsp. **humilis** (Jacq.) Feuillet, **V. cremersii** (Feuillet) Feuillet, and **V. marioniae** (Feuillet) Feuillet. Short comments and a key are provided to help identify the species.

RÉSUMÉ

Le conspectus liste les 17 taxa présents dans la flore du Bouclier Guyanais, ou rejetés, du genre récemment rétabli *Varronia* P. Browne (Cordiaceae). La synonymie et trois combinaisons nouvelles sont présentées: **Varronia bullata** subsp. **humilis** (Jacq.) Feuillet, **V. cremersii** (Feuillet) Feuillet et **V. marioniae** (Feuillet) Feuillet. De brefs commentaires et une clé sont fournis pour aider à identifier les espèces.

On the base of strong morphological and molecular arguments, Miller and Gottschling (2007) resurrected *Varronia* P. Browne for the shrubby species of *Cordia* L. with spicate or condensed inflorescences. *Varronia* species are easily recognized from *Cordia* by their spicate or condensed inflorescences and multi-stemmed habit. They also differ by their leaves usually serrate with a craspedodromous venation and their porate pollen grains.

Following most authors and especially Johnston (1935, 1936), all modern regional treatments included *Varronia* in *Cordia* (Gaviria 1987; Estrada 1995; Miller et al. 1997). Borhidi et al. (1988) had made many new names in *Varronia* for *Cordia* species and Miller (2007) published several new combinations for Central America and the Venezuelan Guayana. The Boraginaceae (Feuillet et al. 2007) in the Checklist of the Plants of the Guiana Shield was at the press when Miller and Gottschling (2007) was published. To provide an update to the checklist and during the preparation of the treatment for Flora of the Guianas, a conspectus of *Varronia* in the flora of the Guiana Shield with three new combinations should help the users and students of the vegetation of northern South America.

The geographical area covered by this paper includes the following administrative or political entities: the three Venezuelan states situated east of the Orinoco River (Amazonas, Bolívar, Delta Amacuro) and the three Guianas (Guyana, Surinam, French Guiana).

1. Varronia bullata L., Syst. Nat., ed. 10, 916. 1759. *Cordia bullata* (L.) Roem. & Schult., Syst. Veg. 4:462. 1819. Type: JAMAICA: *P. Browne s.n.* (holotype: LINN (Savage Catalog number 255.2); microfiche).

Cordia asperrima DC., Prodr. 9:498. 1845. (non *C. asperrima* Spreng.). *Varronia asperrima* (DC.) Fresen, Bull. Soc. Bot. Genève, sér. 2 24:155. 1933. Type: JAMAICA: *Bertero s.n.* (G-DC, microfiche).

Distribution.—Present from Mexico and the West Indies to Peru and Venezuela. Miller et al. (1997) cite Guyana for subsp. *humilis*, but I have not seen a Guyanan specimen for this taxon. In our area, only subsp. *humilis* (next) is present.

1a. Varronia bullata subsp. **humilis** (Jacq.) Feuillet, comb. nov. Basionym: *Varronia humilis* Jacq., Enum. Syst. Pl. 14. 1760. *Cordia humilis* (Jacq.) G. Don, Gen. Hist. 4:383. 1838. *Cordia globosa* var. *humilis* (Jacq.) I.M. Johnst., J. Arnold Arbor. 30:98.

1949. *Cordia globosa* subsp. *humilis* (Jacq.) Borhidi, Bot. Közlem. 58:171. 1971. *Cordia bullata* subsp. *humilis* (Jacq.) Gaviria, Mitt. Bot. Staatssamml. München 23:189. 1987. *Varronia globosa* subsp. *humilis* (Jacq.) Borhidi, Acta Bot. Hung. 34:385. 1988. Type: "Browne, Civ. nat. hist. Jamaica 1:172, t. 13, f. 1" (iconotype).

Varronia dasycephala Desv., J. Bot. (Desv.) 1:274. 1808. *Cordia dasycephala* (Desv.) Kunth, Nov. Gen. Sp. (quarto ed.) 3:76. 1818. Type: VENEZUELA: *Humboldt & Bonpland 23* (holotype: P; isotype: B-W)

Varronia globosa Jacq., Enum. Syst. Pl. 14. 1760. *Cordia globosa* (Jacq.) Kunth, Nov. Gen. Sp. (quarto ed.) 3:76. 1818. Type: "Caribaearum maritimis" (no original material seen).

Distribution.—In our area: Delta Amacuro, Bolívar. Also: Mexico, Central America, West Indies, central and eastern parts of N Venezuela.

Varronia bullata subsp. *humilis* has terminal capitate inflorescences with the fertile part 1.5–2 cm in diameter. The corollas are 7–10 mm long with five lobes deeply emarginate and mucronate. Differing from it, *V. macrocephala* Desv. has stellate trichomes and apically rounded corolla lobes, and *V. bonplandii* Desv. from north central Venezuela and *V. sangrinaria* (Gaviria) J.S. Mill. from western Venezuela have both terminal and axillary inflorescences and unlobed or very shallowly lobed corollas.

2. Varronia cremersii (Feuillet) Feuillet, comb. nov. Basionym: *Cordia cremersii* Feuillet, Novon 13:435. 2003. Type: FRENCH GUIANA: *G. Cremers & J.-J. de Granville 13934* (holotype: US; isotypes:: CAY, NY, P, U).

Distribution.—In our area: known only from the type collection in southern French Guiana, on a rocky outcrop. Endemic.

Varronia cremersii has capitate terminal and axillary inflorescences 1–1.2 cm in diameter, and the styles first branching is near the middle and the second divisions halfway between the first and the tips. It is easily separated from *V. steyermarkii* from Venezuela by the shape of the leaves (cf. key below). It differs from the Brazilian (Bahia) *V. harleyi* (Taroda) J.S. Mill. by its shorter petioles, longer and narrower leaf blades that are cuneate at base and acute to long acute at apex, and its shorter inflorescence peduncles and somewhat smaller corollas (Feuillet 2003).

3. Varronia curassavica Jacq., Enum. Syst. Pl. 14. 1760. *Cordia curassavica* (Jacq.) Roem. & Schult., Syst. Veg. 4:460. 1819. *Lithocardium curassavicum* (Jacq.) Kuntze, Revis. Gen. Pl. 2:977. 1891. Type: DUTCH ANTILLES: Curaçao, *E.P. Killip & L. Smith 1067* (neotype: NY; isoneotype: US).

Lantana bullata L., Sp. Pl. 627. 1753. (non *Varronia bullata* L.) *Montjolya bullata* (L.) Friesen, Bull. Soc. Bot. Genève, sér. 2, 24:142. 1933. Iconotype: Plukenet, Alamg. 393, tab. 221, fig. 3. 1696, "*Salvia barbadensibus dicta, spica florum compactiori.*"

Varronia martinicensis sensu J.B. Aublet, L.C. Richard, Lam., non Jacq. 1760.

Varronia macrostachya Jacq., Enum. Syst. Pl. 14. 1760 (non Ruiz & Pav.). *Cordia macrostachya* (Jacq.) Roem. & Schult., Syst. Veg. 4:461. 1819, "macrostachia" (non Spreng. 1825). *Lithocardium macrostachyum* (Jacq.) Kuntze, Revis. Gen. Pl. 2:977. 1891. Type: COLOMBIA: Cartagena (fide Johnston, 1935).

Varronia guianensis Desv., J. Bot. (Desvaux) 1:270. 1809. *Cordia gujanensis* (Desv.) Roem. et Schult., Syst. Veg. 4:460. 1819. *Montjolya guianensis* (Desv.) Friesen, Bull. Soc. Bot. Genève, sér. 2, 24:142. 1933. Type: FRENCH GUIANA: *Ex herb. Richard s.n.* (holotype: P; isotype: P).

Cordia divaricata Kunth, Nov. Gen. Sp. 3:74. 1818. *Lithocardium divaricatum* (Kunth) Kuntze, Revis. Gen. Pl. 2:977. 1891. *Varronia divaricata* (Kunth) Borhidi, Acta Bot. Hung. 34(3–4):391. 1988. Type: VENEZUELA: *Humboldt & Bonpland 72* (holotype: P; isotype: B-W, photo. F, US)

Cordia graveolens Kunth, Nov. Gen. Sp. 3:74. 1818. *Cordia cylindrostachya* var. *graveolens* (Kunth) Griseb., Fl. Brit. W.I. 480. 1861. *Varronia graveolens* (Kunth) Borhidi, Acta Bot. Hung. 34(3–4):391. 1988. Type: VENEZUELA: *Humboldt & Bonpland 1074* (holotype: P; isotype: B-W)

Cordia canescens Kunth, Nov. Gen. Sp. 3:75. 1818. *Lithocardium canescens* (Kunth) Kuntze, Revis. Gen. Pl. 2:976.1891. *Varronia canescens* (Kunth) Borhidi, Acta Bot. Hung. 34(3–4):390. 1988 (non Andersson 1853). Type: COLOMBIA: *Humboldt & Bonpland s.n.* (holotype: P; isotype: B-W, photo. F, US)

Cordia spicata Willd. ex Roem. & Schult., Syst. Veg. 4:799. 1819. Type: VENEZUELA: *Humboldt & Bonpland s.n.* (holotype: B-W; isotype: P)

Cordia rugosa Willd. ex Roem. & Schult., Syst. Veg. 4:801. 1819. Type: VENEZUELA: *Humboldt & Bonpland s.n.* (holotype: B-W; photo P)

Cordia interrupta DC., Prodr. 9:491. 1845. *Cordia cylindrostachya* var. *interrupta* (DC.) Griseb., Fl. Brit. W.I. 480. 1861. *Lithocardium cylindrostachyum* var. *interruptum* (DC.) Kuntze, Revis. Gen. Pl. 2:438. 1891. GUYANA: *Hostmann 323* (lectotype: G-DC). The specimen cited in the text by A.P. de Candolle, *"Perrottet" 212*, from French Guiana, is a mixture (fide Johnston 1935). In an infra note, Alph. de Candolle said "et circa Surinam legit Hostmann ! 323 in h. Boiss."

Cordia verbenacea DC., Prodr. 9:491. 1845. Type: BRAZIL: *Gaudichaud 532* (holotype: G-DC; isotypes: NY, DL)

Cordia cuneiformis DC., Prodr. 9:492. 1845. *Lithocardium cuneiforme* (DC.) Kuntze, Revis. Gen. Pl. 2:976. 1891. *Varronia cuneiformis* (DC.) Borhidi, Acta Bot. Hung. 34(3–4):391. 1988. TYPE: VENEZUELA: *Vargas(?18) 90* (G-DC)

Cordia oxyphylla DC., Prodr. 9:492. 1845. *Lithocardium oxyphyllum* O. Kuntze, Revis. Gen. Pl. 2:977. 1891. TYPE: GUYANA: *Parker s.n.* (G-DC).

Cordia salicina DC., Prodr. 9:492. 1845. *Lithocardium salicinum* (DC.) Kuntze, Revis. Gen. Pl. 2:977. 1891. TYPE: BRAZIL: *Vauthier 204* (HOLOTYPE: G-DC; ISOTYPE: GH).

Cordia cylindrostachya sensu Schomburgk, Fauna Fl. Brit. Guiana 960. 1848 (non (Ruiz & Pav.) Roem. & Schult. 1819).

Varronia cylindrostachya sensu Graham, Ann. Carnegie Mus. 22:240. 1934 (non Ruíz & Pav. 1799).

Distribution.—In our area: Delta Amacuro, Bolívar, northern Amazonas, Guyana, Surinam, French Guiana; especially common near beaches. Also: Mexico, Central America, West Indies, South America except Chile and Uruguay, mostly in dry vegetation below 2000 m.

Varronia curassavica is characterized by leaf blades that have, at least in our area, adaxially smooth or with trichomes short erect or more often reduced to their wide conical base and abaxially with curved trichomes limited to the veins, and spicate inflorescences that are terminal or opposite to the leaves or internodal, but not axillary.

4. **Varronia grandiflora** Desv., J. Bot. (Desvaux) 1:273. 1808. *Cordia grandiflora* (Desv.) Kunth, Nov. Gen. Sp. 3:77. 1818. *Lithocardium grandifolium* (Desv.) Kuntze, Revis. Gen. Pl. 2:977. 1891. TYPE: VENEZUELA. *Humboldt & Bonpland 805* (HOLOTYPE: P; ISOTYPES: B-W, P).

[*Cordia rufa*] Kl. in Schomburgk, Reis. Br. Guiana 960. 1848, nom. nud.

Distribution.—In our area: Delta Amacuro, northern Bolívar, northwestern Amazonas, Guyana. Also: Colombia, Venezuela, northern Brazil.

Varronia grandiflora has terminal capitate inflorescences with unlobed corollas more than 3 cm long.

5. **Varronia marioniae** (Feuillet) Feuillet, comb. nov. BASIONYM: *Cordia marioniae* Feuillet, Novon 13:436. 2003. TYPE: GUYANA, Rupununi District, Dadanawa, 120 m elev., 2°49'N, 59°31'W, 6 June 1995, fl. & fr., *M.J. Jansen-Jacobs, B.J.H. ter Welle, C. Gustafsson & V. James 3931* (HOLOTYPE: US; ISOTYPES: BRG, GB, MO, U).

Distribution.—In our area: SW Guyana. Endemic.

Varronia marioniae has characteristic obovate leaf blades attenuate at base and round at apex, spicate inflorescences terminal or axillary, and emarginate corolla lobes.

6. **Varronia polycephala** Lam. Tabl. Encycl. 1:418. 1791. *Cordia polycephala* (Lam.) I.M. Johnst., J. Arnold Arbor. 16:33. 1935. ICONOTYPE: Plukenet, Phytogr. tab. 328, fig. 5. 1691. (see J.E. Sanchez, Fl. Colombia 14:45. 1995).

Lantana corymbosa L., Sp. Pl. 2:628. 1753. TYPE: JAMAICA.

Cordia corymbosa Willd. ex Roem. & Schult., Syst. Veg. 4:801. 1819. *Varronia macrostachya* Jacq., Enum. Syst. Pl. 14. 1760. *Cordia macrostachya* (Jacq.) Roem. & Schult., Syst. Veg. 4:461. 1819, "macrostachia." *Lithocardium macrostachyum* (Jacq.) Kuntze, Revis. Gen. Pl. 2:977. 1891. TYPE: VENEZUELA: Camara, *Humboldt & Bonpland* (B-W).

Varronia martinicensis sensu J.B. Aublet, L.C. Richard, non Jacq. 1760. TYPE: VENEZUELA: *Humboldt & Bonpland s.n.* (HOLOTYPE: B-W).

Cordia mariquitensis Kunth, in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 3:75. 1818. *Lithocardium mariquitense* (Kunth) Kuntze, Revis. Gen. Pl. 2:977. 1891. *Ulmarronia mariquitensis* (Kunth) Friesen, Bull Soc. Bot. Genève, sér. 2, 24:181. 1933. *Varronia mariquitensis* (Kunth) Borhidi, Acta Bot. Hung. 34:389. 1988. TYPE: COLOMBIA: Tolima (P).

Varronia monosperma Jacq., Pl. Hort. Schoenbr. 1:18, t. 39. 1797. *Cordia monosperma* (Jacq.) Roem. & Schult., Syst. Veg. 4:463. 1819. *Varronia corymbosa* Desv., J. Bot. (Desvaux) 1:275. 1809, illeg. (renaming of *V. monosperma* Jacq. 1797), non L. ex Desf. 1804, nom. nud. *Cordia corymbosa* (Desv.) G. Don, Gen. Hist. 4:383. 1838, non Willd. ex Roem. & Schult. 1819. ICONOTYPE: VENEZUELA: "*Ex Caracas. In caldario floret totem aestatem, fructusque fert maduros.*"

Distribution.—In our area: eastern Bolívar, Guyana, Surinam. Miller et al. (1997) cite French Guiana for *Cordia polycephala*, but I have not seen a specimen of this taxon from this French region. Also: West Indies, Colombia, Venezuela, northern and coastal Brazil.

Varronia polycephala has inflorescences adnate to the petiole, branched, usually bearing a few reduced leaves and with at extremities capitate-looking condensed cymes, and corollas 5–7 mm long, unlobed. Contrary to the capitate inflorescence species, the calyx lobes are not acuminate and without tips projecting freely from closed bud.

7. Varronia polystachya (Kunth) Borhidi, Acta Bot. Hung. 34:393. 1988. *Cordia polystachya* Kunth, Nov. Gen. Sp. 3:73 [quarto]. 1818. *Lithocardium polystachyum* (Kunth) Kuntze Revis. Gen. Pl. 2:977. 1891. Type: VENEZUELA: *Humboldt & Bonpland 1146* (holotype: P; isotypes: B-W, P).

Cordia canescens Willd. ex Roem. & Schult., Syst. Veg. 4:797. 1819, non Kunth 1818. Type: VENEZUELA: Prope Maypure, *Humboldt & Bonpland s.n.* (B-W)

Distribution.—In our area: Amazonas. Endemic. To be expected in neighboring Colombia.

Varronia polystachya has spicate inflorescences that are terminal and axillary, adnate or not to the petiole, petiole up to 5 mm long and 5-lobed corollas. It differs from *V. schomburgkii*, which has inflorescences always adnate to the petioles, by the young branches lacking curly trichomes, petioles 10–12 mm long and conical to campanulate calyx, and from *V. stenostachya* which has petiole longer than 8 mm and unlobed corollas.

8. Varronia roraimae (I.M. Johnst.) J.S. Mill., Novon 17:374. 2007. *Cordia roraimae* I.M. Johnst. Fieldiana, Bot. 28:511. 1953. Type: VENEZUELA: Bolívar, Mt. Roraima, *J. Steyermark 59003* (holotype: F; isotypes: GH, US, VEN).

Distribution.—In our area: Bolívar. Endemic.

Varronia roraimae has spicate inflorescences terminal and axillary, adnate to the petioles, the fertile part is short and narrowly ovoid to narrowly elliptic, subglobose when young, and unlobed corollas. Contrary to *V. tomentosa*, it has calyx lobes that are not acuminate.

9. Varronia schomburgkii (DC.) Borhidi, Acta Bot. Hung. 34:393. 1988. *Cordia schomburgkii* A. DC., Prodr. 9:490. 1845. *Lithocardium schomburgkii* (DC.) Kuntze Revis. Gen. Pl. 2:977. 1891. Type: GUYANA: *Rob. Schomburgk ser. 1, 406* (holotype: G-DC; isotypes: BM, K, L, P, U, W).

Cordia aubletii sensu Pulle, Schomburgk non DC. 1845.
[*Cordia lucida*] Splitg. ex Pulle, Enum. Vasc. Pl. Surinam 397. 1906, nom. nud. Based on *Splitgerber 206* (L).
Cordia patens var. *polycephala* sensu Miquel, non (as form) Cham. & Schltdl. 1829.
Cordia tobagensis Urban, Repert. Spec. Nov. Regni Veg. 16:39. 1919. *Varronia tobagensis* (Urb.) Borhidi Acta Bot. Hung. 34:393. 1988. Type: TOBAGO: *Broadway 4235* (holotype: B n.v.; isotype: GH).
Cordia tobagensis Urban var. *broadwayi* Urban, Repert. Spec. Nov. Regni Veg. 16:40. 1919. Type: TOBAGO: *Broadway 3072* (holotype: B n.v.; isotype: GH).
Varronia guianensis sensu Graham.

Distribution.—In our area: Bolívar, Guyana, Surinam, French Guiana. Also: Trinidad-Tobago, northern Brazil.

Varronia schomburgkii has terminal and axillary, spicate inflorescences adnate to the petioles. The leaves are adaxially strigose and somewhat shiny. The inflorescences are up to 25 cm long, including the fertile and loosely flowered part 5–15 cm long. In flowers, the calyces are enlarged and cup-shaped above a short tube or seldom from the narrow base, they are covered with small resinous granules, the lobes are strigose outside, especially toward the apex. Like most spicate inflorescence species, it has calyx lobes that are not acuminate and lack tips projecting freely from closed buds. In contrast, *V. spinescens* (L.) Borhidi from western Venezuela has calyces with scattered resinous granules that are strigose but at the very base, the trichomes on the calyx tube are sometimes hirsute.

10. Varronia stenostachya (Gaviria) J.S. Mill., Novon 17:375. 2007. *Cordia stenostachya* Killip ex Gaviria, Mitt. Bot. Staatssamml. München 23:243, fig. 1987. Type: VENEZUELA: *R. Spruce 3642* (holotype: K; isotypes: K, W).

Distribution.—In our area: Amazonas (Raudal de Maipures), Guyana (Mt. Shiriri). Endemic of granitic outcrops.

Varronia stenostachya has terminal and axillary, spicate inflorescences not adnate to the petiole that have a thinner peduncle and fertile part than other species in our area. The petioles are 0.7–2.5 cm long and the corollas are unlobed.

11. Varronia steyermarkii (Gaviria) J.S. Mill., Novon 17:375. 2007. *Cordia steyermarkii* Gaviria, Mitt. Bot. Staatssamml. München 23:200. 1987. Type: VENEZUELA: *J. Saer d'Heguert 480* (holotype: M; isotypes: F, VEN).

Distribution.—In our area: Bolívar. Also: Northern Venezuela.

Varronia steyermarkii has terminal capitate inflorescences and leaves with linear-elliptic blades and petioles less than 3 mm long. The style is branching near the apex with short branches.

12. Varronia tomentosa Lam., Tabl. Encycl. 1(v. 2):419. 1792. *Cordia tomentosa* (Lam.) Roem. & Schult., Syst. Veg., ed. 15 bis [Roemer & Schultes] 4:459. 1819. *Lithocardium tomentosum* (Lam.) Kuntze Revis. Gen. Pl. 2:977. 1891. *Montjolya tomentosa* Friesen Bull. Soc. Bot. Genève ser. 2, 24:183. 1933. TYPE: FRENCH GUIANA: s.loc., from *herb. Jussieu* (P-Lamarck).

Varronia martinicensis sensu Aublet, Hist. Pl. Guiane 1:232. 1775 (non Jacq. 1760).

Cordia aubletii DC., Prodr. 9:490. 1845. *Lithocardium aubletii* (DC.) Kuntze, Revis. Gen. Pl. 2:976. 1891. *Varronia aubletii* (DC.) Borhidi Acta Bot. Hung. 34(3–4):389. 1988. TYPE: FRENCH GUIANA: *Perrottet 211* (G-DC).

Distribution.—In our area: Surinam, French Guiana. Endemic.

Varronia tomentosa has spicate inflorescences that are terminal or axillary and adnate to the petioles. The leaves are adaxially dull, scabrous with stiff ascending bristles. The inflorescences are up to 15 cm long, including the fertile and densely flowered part 1.5–4 cm long and often club-shaped. The calyx tubes are densely hairy or tomentose with intermixed resinous granules. Contrary to the other species with spicate inflorescences in our area, even *V. roraimae* with short fertile parts, the calyx lobes of *V. tomentosa* are narrowly triangular and acuminate and with acumen projecting freely from closed bud.

EXCLUDED SPECIES

Varronia cylindrostachya Ruíz & Pav., Fl. Peruv. 2:23. 1799. *Cordia cylindrostachya* (Ruíz & Pav.) Roem. & Schult., Syst. Veg. 4:459. 1819. TYPE: Fl. Peruv. 2: pl 147a "macrostachya." 1799.

Distribution.—From Venezuela to Peru. Specimens identified as *C. cylindrostachya* in our area represent *V. schomburgkii*.

Varronia ferruginea Lam., Tab. Encycl. 1:418. 1791. TYPE: Ex horto (HOLOTYPE: P-LA). *Cordia ferruginea* (Lam.) Roem. & Schult., Syst. Veg. 4:458. 1819. = *Varronia spinescens* (L.) Borhidi, Acta Bot. Hung. 34:393. 1988. (cf. below).

Specimens identified as *C. ferruginea* in our area represent *V. schomburgkii*.

Varronia multispicata (Cham.) Borhidi, Acta Bot. Hung. 34(3–4):392. 1988. *Cordia multispicata* Cham., Linnaea 4:490. 1829. *Lithocardium multispicatum* (Cham.) Kuntze, Rev. Gen. 2:977. 1891. TYPE: BRAZIL: *Sellow 46* (HOLOTYPE: B, extant?; ISOTYPE: US).

Distribution.—Coastal Brazil. Does not reach the Guianas.

Varronia spinescens (L.) Borhidi, Acta Bot. Hung. 34:393. 1988. *Cordia spinescens* L., Mant. Pl. 2:206. 1771. LECTOTYPE: LINN (Savage catalog N° 253.2) (cf. Miller, 1988).

Distribution.—From S Mexico to Bolivia and western Venezuela.

This species has a conical calyx at anthesis. Specimens so identified in our area represent *V. schomburgkii*. *Varronia spinescens* is not present either in the Venezuelan states neighboring Venezuelan Guayana.

KEY TO THE *VARRONIA* SPECIES OF THE GUIANA SHIELD

1. Inflorescences capitate or cymose very condensed.
   2. Flower heads < 5 mm diam, calyx lobes not acuminate **V. polycephala**
   2. Flower heads > 5 mm diam, calyx lobes acuminate, acumen projecting freely from closed bud.
      3. Peduncles > 5 cm long; corollae > 2 cm long **V. grandiflora**
      3. Peduncles mostly < 4 cm long; corollae < 1.5 cm long.
         4. Petiole at least 5 mm long; calyx lobes rounded, abruptly long acuminate **V. bullata** subsp. **humilis**
         4. Petiole up to 5 mm long.
            5. Leaves ovate, seldom elliptic; peduncle 0.7–2 cm long; corolla lobes broadly elliptic, rounded at apex, 0.7–1 × 0.5 mm **V. cremersii**
            5. Leaves linear to narrow-elliptic; peduncle 1–4 cm long; corolla lobes triangular, acute at apex, 1.5–2 × 1.5–2 mm **V. steyermarkii**
1. Inflorescences spicate.
   6. Inflorescences terminal or opposite to the leaves or internodal, but never truly axillary **V. curassavica**
   6. Inflorescences axillary or terminal and axillary, sometimes adnate to the petiole at base.

7. Calyx lobes acuminate, acumen projecting freely from closed buds ____ **V. tomentosa**
7. Calyx lobes not acuminate.
  8. Inflorescences peduncles adnate to the petiole base.
    9. Leaf blades adaxially dull; inflorescences densely flowered; corolla crenate (not 5-lobed) ____ **V. roraimae**
    9. Leaf blades adaxially shiny; inflorescences loosely flowered (with irregular gaps between groups of flowers).
      10. Calyx cup-shaped with (seldom without) a short tubular base; corolla with 5 teeth ____ **V. schomburgkii**
      10. Calyx wide conical or campanulate; corolla without 5 teeth ____ **V. polystachya**
  8. Inflorescences peduncles not adnate to the petiole base.
    11. Corolla not lobed ____ **V. stenostachya**
    11. Corolla 5-lobes.
      12. Leaf blades elliptic, acute at apex ____ **V. polystachya**
      12. Leaf blades obovate, widely rounded at apex ____ **V. marioniae**

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A NEW SPECIES OF THE FERN GENUS *DORYOPTERIS* (PTERIDACEAE) FROM SOUTHEASTERN BRAZIL

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ABSTRACT

Doryopteris jequitinhonhensis Salino, known only from Minas Gerais, Brazil, is described and illustrated. The new species belongs to Section *Doryopteris* due to the stipes with one vascular bundle at the base and areolate venation. *Doryopteris jequitinhonhensis* is apparently more close to *D. trilobata* J. Prado (Bahia, Brazil) and *D. cordifolia* (Baker) Diels (Madagascar) because of deeply 3-lobed lamina of its fertile fronds, the lanceolate lobes with an acute apex, the apical much larger than the basal lobes. *Doryopteris jequitinhonhensis* differs from both species by sterile leaves with margin hyaline, not sclerified, usually crenate, and petiole puberulous, with trichomes up to 0.1 mm long, with isodiametric cells. From *D. cordifolia* differs by fronds with margins not sclerified and absence of proliferous buds; from the *D. trilobata* differs by rhizome erect to decumbent and petiole sulcate adaxially.

KEY WORDS: Pteridaceae, *Doryopteris*, Minas Gerais, Brazil

RESUMO

Doryopteris jequitinhonhae Salino que é conhecida apenas de Minas Gerais, Brasil é descrita e ilustrada. A nova espécie pertence à Seção *Doryopteris* por possuir a base do pecíolo com um feixe vascular e venação areolada. *Doryopteris jequitinhonhensis* é aparentemente mais próxima de *D. trilobata* J. Prado (Bahia - Brasil) e *D. cordifolia* (Baker) Diels (Madagascar) pela lâmina fértil trilobada, lobos lanceolados com ápice agudo e lobo apical maior que os lobos basais. *Doryopteris jequitinhonhensis* difere pela fronde estéril com margem não cartilaginosa, geralmente crenada e pecíolo puberulento com tricomas até 0.1 mm de comprimento e com células isodiamétricas. Difere também de *D. cordifolia* pela ausência de gemas na base da lâmina estéril, e de *D. trilobata* pelo caule ereto ou decumbente, e pecíolo sulcado adaxialmente.

PALAVRAS CHAVE: Pteridaceae, *Doryopteris*, Minas Gerais, Brazil

INTRODUCTION

Doryopteris is a genus of about 30 species mostly of the southeastern Brazilian Highlands, with five endemic to Madagascar and one pantropical (Mickel & Smith 2004). Besides an early revision by Tryon (1942) and the surveys of Brade (1965), Tryon (1962) and Sehnem (1972), nothing more on the taxonomy of the Brazilian species of the *Doryopteris* has been published, except a new endemic species from the Cadeia do Espinhaço by Prado (1993), and a new species from the Atlantic forest (Yesilyurt 2007).

TAXONOMIC TREATMENT

Doryopteris jequitinhonhensis Salino, sp. nov. (**Fig. 1**). TYPE: BRAZIL. MINAS GERAIS: Salto da Divisa, fazenda Santana, ao longo do riacho da Penha (afluente do rio Jequitinhonha), 134 m alt., 16° 03'41.5"S, 40°03'23.5"W, 04 Mar 2004, *A. Salino, J.A. Lombardi, R.C. Mota, T.E. Almeida & P.L. Viana 9425* (HOLOTYPE: BHCB).

Plantae terrestres. Rhizoma erectum vel decumbens. Frondes dimorphae et membranaceae; frons sterilis 3.3–5.9 × 0.9–1.95 cm; frons fertilis 9–10 × 0.75–0.82 cm; petiolus semi-cylindricus, sulcatus in facie adaxiali; lamina sterilis integra, oblonga vel obovata, ad basin cordata vel sagitata, margine non cartilaginea, crenata, rare integra; lamina fertilis hastata vel trilobata. *Doryopteri cordifoliae* (Baker) Diels et *D. trilobatae* J. Prado similis, ab eis fronde sterili margine non cartilaginea, generaliter crenata et petiolo puberulento trichomatibus ad 0.1mm longa munito differt. A *D. cordifolia* absentia gemmarum base laminae sterilis distat et a *D. trilobata* rhizomate erecto vel decumbenti, et petiolo sulcato adaxialiter distat.

Plants terrestrial. **Rhizome** erect to decumbent; scales linear to linear-lanceolate, with acute to acuminate apex, 1–1.3 mm long, with sclerified dark brown band, margin hyaline. **Fronds** dimorphic, erect; sterile frond 3.3–5.9 × 0.9–3 cm, fertile frond 9–10 × 1.5–3 cm; petiole semi-terete, adaxially sulcate, 17–28 ×

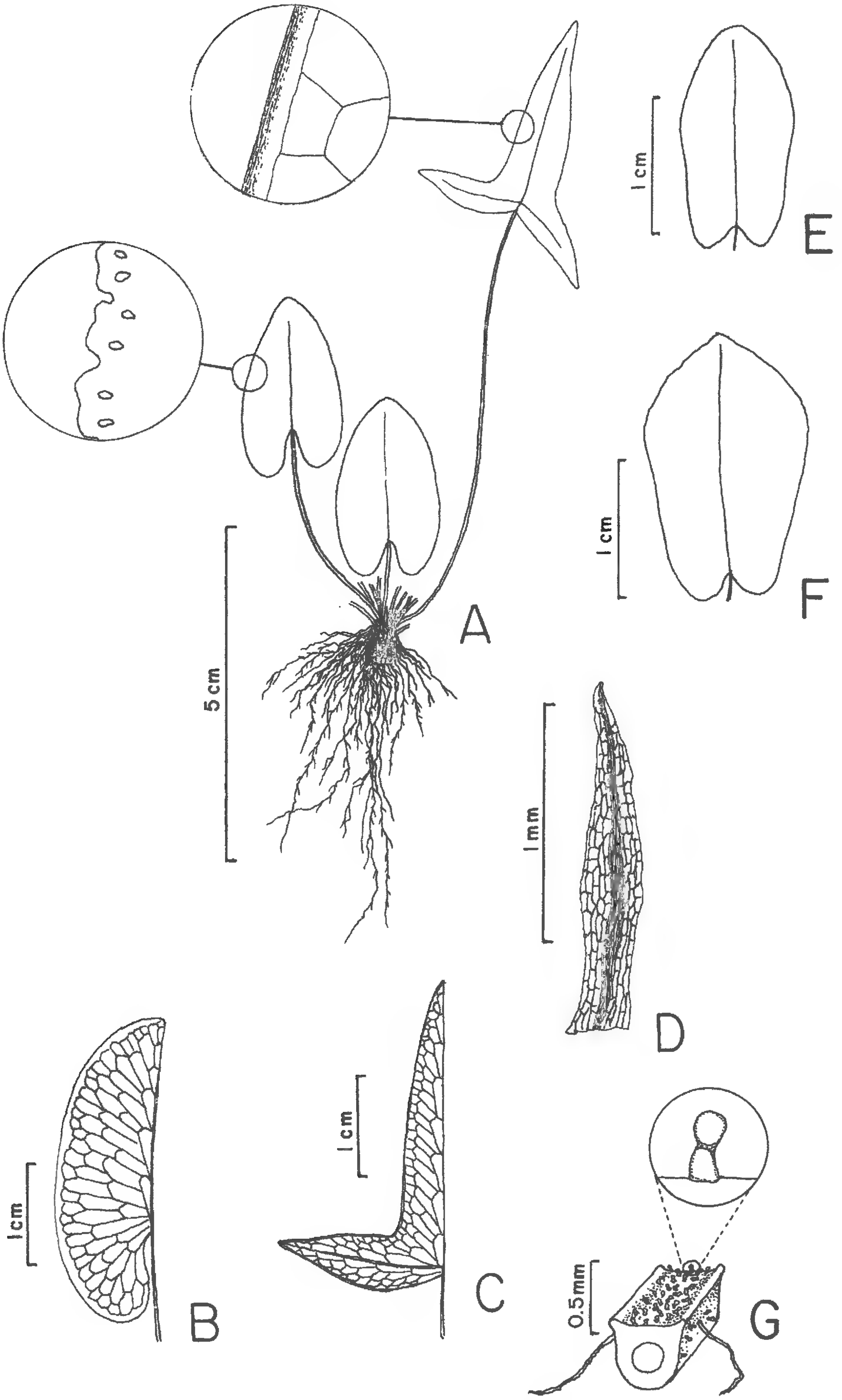

FIG. 1. *Doryopteris jequitinhonhensis*. A. Habit and details of the margins of the sterile and fertile fronds showing hydathodes and venation, respectively. B. Venation of the sterile frond. C. Venation of the fertile frond. D. Rhizome scale. E. Sterile frond. F. Sterile frond. G. Portion of petiole showing adaxial groove, one cylindrical vascular bundle, ciliate trichomes on lateral surface and capitate trichomes mainly on adaxial groove, and detail of the capitate trichome (from *Salino et al. 9425*, BHCB).

0.38–0.58 mm in the sterile fronds, and 65–70 × 0.6–0.7 mm in fertile fronds, dark brown with one cylindrical vascular bundle at the base, basal scales (sometimes into the apical part) similar to those of the rhizome, but with or without sclerified dark brown central band, puberulous, trichomes capitate, up to 3-celled, and up to 0.1 mm long, light brown on adaxial surface, and with ciliform trichomes, 0.7–1.5 mm long on lateral surfaces; lamina of the sterile frond entire, oblong or obovate with deeply cordate base or, sagitate, apex obtuse, rounded or acute, margin hyaline, not sclerified, usually crenate, rarely entire; hydathodes present on the upper surface; lamina of the fertile frond hastate, deeply 3-lobed, lobes entire, lanceolate, apex acute, margin revolute, apical lobe larger than basal lobes, basal lobes forming a right angle to the apical lobe, lamina of the both types of frond membranaceous to papyraceous, glabrous on both surfaces or glabrescent on adaxial surface, trichomes ciliform, light brown, venation completely areolate on both types of fronds without enclosed veinlets, and usually without free veins near the margin. **Sorus** marginal in vascular comissure, continuous, including the sinus region, absent at the apex of the lobes; indusium formed by the revolute margin; spores trilete, tetrahedral-globose, castaneous, sparsely cristate.

Etymology.—The specific epithet refers to the occurrence of the species only in the forest along the Jequitinhonha River in Brazil.

Doryopteris jequitinhonhensis belongs in section *Doryopteris* due to the petioles with one vascular bundle at base and areolate venation. *Doryopteris jequitinhonhensis* is apparently closely related to *D. trilobata* J. Prado (from Bahia, Brazil) and *D. cordifolia* (Baker) Diels (from Madagascar) mainly in the deeply 3-lobed form of the lamina of its fertile fronds, the lanceolate lobes with an acute apex, the apical much larger than the basal lobes, and in the cordiform base of the sterile lamina. *Doryopteris jequitinhonhensis* differs from both species by sterile leaves with margin hyaline, not sclerified, usually crenate, and petiole puberulous, with capitates trichomes up to 0.1 mm long. From the *D. cordifolia* differs by fronds with margins not sclerified and absence of proliferous buds; from the *D. trilobata* differs by rhizome erect to decumbent and petiole sulcate adaxially.

In the general aspect (habit and shape of the sterile frond) *D. jequitinhonhensis* resembles *D. rufa* Brade, but this species has fronds that are coriaceus with free venation, and belongs to the section *Lytoneuron*. An identification key is presented to distinguish *D. jequitinhonhensis* from other similar Brazilian species.

Distribution.—Known only from the type collection from a population with about 30 individuals growing only along stream banks inside the deciduous forest in lowlands (100–170 m). *Doryopteris trilobata* and *D. rufa* grow in open rocky habitats in the highlands (1200–1500 m).

KEY TO SPECIES *DORYOPTERIS* OF SOUTHEASTERN BRAZIL SIMILAR TO *DORYOPTERIS JEQUITINHONHENSIS*

1. Venation of both sterile and fertile fronds free; rhizome scales with apex filiform ____ **D. rufa**
1. Venation of both sterile and fertile fronds areolate; rhizome scales with apex acute to acuminate.
    2. Rhizome erect to decumbent; petiole semi-terete, sulcate adaxially, puberulous with capitate trichomes up to 0.1 mm; fronds membranaceous with margins not sclerified, usually crenate ____ **D. jequitinhonhensis**
    2. Rhizome short-creeping; petiole terete without capitate trichomes up to 0.1 mm; fronds coriaceous with margins sclerified and entire____ **D. trilobata**

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NEW RECORDS OF *POA* (POACEAE) AND *POA PFISTERI*: A NEW SPECIES ENDEMIC TO CHILE

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ABSTRACT

The distributions of several narrowly endemic species of *Poa* in Chile and Argentina are discussed. *Poa hachadoensis* var. *pilosa* and *P. mendocina* are newly reported for Chile. **Poa pfisteri** is described as a new species endemic to Chile. A key to *Nicoraepoa* and *Poa* species (except species of *Poa* sect. *Dioicopoa*) that grow in Chile from Coquimbo southward is provided.

RESUMEN

Se discuten las distribuciones restringidas de varias especies endémicas de *Poa* en Chile y Argentina. Tanto *P. hachadoensis* var. *pilosa* como *Poa mendocina* se citan nuevamente para Chile. **Poa pfisteri** se describe como una nueva especie endémica de Chile. Se da una clave de las especies de *Nicoraepoa* y de *Poa* (excepto las especies de *Poa* sect. *Dioicopoa*) que crecen en Chile de Coquimbo hacia el sur.

The genus *Poa* L. is highly developed in Argentina and Chile with 58 and 39 species, respectively, accepted by Soreng et al. (2003, on-line version updated Jan 2008) in the Catalogue of New World Grasses (http://mobot.mobot.org/W3T/Search/nwgc.html). Most of the Chilean species are shared with Argentina. Only two species of *P.* sect. *Dioicopoa* E. Desv. (*P. cumingii* Trin. and *P. paposana* Phil.), and one new species described here, are thought to be endemic to Chile whereas 20 species are considered to be endemic to Argentina (Soreng et al. 2003, updated Jan 2008). Other than the Soreng et al. (2003) index, *Poa* has not been systematically treated in Chile since the early accounts by Desvaux (1854), Steudel (1854), and by R.A. Philippi who named 36 new species between 1858 and 1891 (see Muñoz Pizarro 1960). Regional floras for Patagonia (Nicora 1978) and Tierra del Fuego (Moore 1983) include species of *Poa* that occur in the southern third of Chile; these include keys, descriptions, and illustrations. Negritto and Anton (2000) revised the genus for the five northwestern provinces of Argentina, and Giussani (2000) revised Argentina's taxa of *P.* sect. *Dioicopoa*. These treatments leave a major gap in our knowledge for the occurrence of *Poa* in Chile, especially for the northern two-thirds of the country. Marticorena and Quezada (1985), with assistance of Oscar Matthei, pared down the number of accepted species of *Poa* in Chile to 65 (no synonyms were listed). As Marticorena and Quezada (1985) suggested, the nomenclature and taxonomy of many large genera in Chile was in chaos, and their listing of taxa in these genera was only provisional. For example, of the 36 species of *Poa* named by R.A. Philippi only three are accepted today (Soreng et al. 2003, updated on-line in Jan 2008; includes distribution by country, synonymy, and classification with species placed in an infrageneric arrangement).

From November 2001 to February 2002 RJS (R.J. Soreng) visited Chile to collect and study the genus *Poa* in the region. In CONC (Universidad de Concepción) and SGO (Museo Nacional de Historia Natural, Santiago), the two main herbaria in Chile, herbarium specimens were found that appeared to represent seven new taxa and another specimen was newly collected that potentially seemed to be new to science. RJS was able to recollect all but one of them in Chile or on subsequent trips with PMP (P.M. Peterson) to Argentina (2003 and 2006). This paper describes the fate of these eight unknowns, five of which were recently identified as occurring in Chile (Soreng et al. 2003), and one that is described here as a new species endemic to Chile.

Three of these unknowns, *Poa planifolia* Kuntze, *P. subenervis* var. *spegazziniana* Nicora, and *P. pugioni-*

folia Speg., were identified more readily than the others by comparison with type material. There are no keys to identify the first two species. Although Muñoz Pizarro (1941) considered the first to be a Chilean species from the type locality of Paso Cruz, Marticorena and Quezada (1985) did not mention it for Chile, presumably as it had not been verified as occurring on their side of the border. The second two were reported as occurring in Chile for the first time by Soreng et al. (2003), with some newer stations for them reported by Soreng and Gillespie (2007). *Poa planifolia* and *P. subenervis* var. *spegazziniana* were found in the high arid Andean valleys east of Santiago, and *P. pugionifolia* (often misspelled as "*pungionifolia*") was found in the Region of Magallanes, Province of Última Esperanza in the Sierra Baguales, along with *P. subenervis* var. *subenervis* that in Chile is also only known from this interesting mountain range. Soreng and Gillespie (2007) transferred the later two species to the new genus *Nicoraepoa* Soreng & L.J. Gillespie, as *N. pugionifolia* (Speg.) Soreng & L.J. Gillespie and *N. subenervis* (Hack.) Soreng & L.J. Gillespie [with subsp. *subenervis* and subsp. *spegazziniana* (Nicora) Soreng & L.J. Gillespie], along with four other Patagonian species previously separated as *Poa* subgen. *Andinae* Nicora; now *N. andina* (Trin.) Soreng & L.J. Gillespie, *N. chonotica* (Phil.) Soreng & L.J. Gillespie, *N. erinacea* (Speg.) Soreng & L.J. Gillespie, and *N. robusta* (Steud.) Soreng & L.J. Gillespie.

Although also reported from several locations in Argentina, two other unidentified specimens were attributable to *Nicoraepoa subenervis* subsp. *subenervis* and *Poa hachadoensis* Nicora var. *hachadoensis*, previously reported from single collections in Chile (Nicora 1977, 1978). These taxa were accepted by Marticorena and Quezada (1985) as occurring in Chile, but no vouchers had yet been identified for these taxa at CONC or SGO.

Three remaining unidentified specimens were still potentially considered to be new species of *Poa*, and these, along with new vouchers for *P. hachadoensis* var. *hachadoensis* are discussed below.

RESULTS AND DISCUSSION

Poa mendocina Nicora & F.A. Roig.—One specimen from the high Andes east of Santiago (*Villagrán et al. 8484*) certainly seemed new, until in 2003 a similar herbarium specimen from 3100 m in the Province of Mendoza, Argentina, named "*Poa mendocina* ined." was discovered at BAA. This isotype had been filed in the general collections rather than with the types at BAA, and thus was buried in this large genus. Only later was it realized that *Poa mendocina* was already published and illustrated by Nicora & Roig (1998). This name had made it into the Catalogue of New World Grasses as a tentatively accepted taxon, endemic to Argentina (Zuloaga et al. 2008), as it was then known only from the type and a paratype that had not been seen by Soreng et al. (2003). On another collecting trip to Argentina in 2006 we recollected this species in the same region of Mendoza as the type.

Poa mendocina is in a distinctive species of *Poa*, now known from four localities in Argentina and Chile. However, *Poa mendocina* is not included in a key, descriptive floristic account, or revision of the genus in Chile. *Poa mendocina* has bisexual spikelets, short anthers (ca. 1 mm long), and lemmas with soft hairs along the lower portion of the keel and marginal nerves. Most of the lower florets have a sparse but distinct web of hairs on the dorsal side of the callus. In the treatment of *Poa* in northwest Argentina (Negritto & Anton 2000) this species keys out to *P. laetevirens* R.E. Fr. However, *P. mendocina* has relatively longer glumes that are subequal to their adjacent lemmas, and longer spikelets. In the Flora Patagónica *Poa* treatment (Nicora 1978) *P. mendocina* keys to either *Poa scaberula* Hook.f. or *P. hachadoensis* Nicora. *Poa mendocina* differs from the former species by having much larger spikelets that are few in number, and from *P. hachadoensis* by having a shorter stature, and short compact panicles. *Poa mendocina* superficially resembles *P. subspicata* (J. Presl) Kunth, a more northern species that occurs in Colombia, Venezuela, and Ecuador to the Departments of Ancash and Junín, Peru (and one record from Bolivia, Province of La Paz—*Solomon 15876*, MO—that requires verification). *Poa mendocina* differs from *P. subspicata* by having shorter panicles and by lacking hairs between the lemma keel and marginal veins. *Poa mendocina* is likely very closely related to *Poa hachadoensis* var. *pilosa*. However, *P. mendocina* is only 2–15 cm tall, with contracted, compact, 1–4.5 cm long panicles that have steeply ascending branches to 1 cm long (versus 18–50 cm tall, with wide open, [4–]4.5–12 cm long panicles with spreading branches 1.5–4 cm long). Nicora and Roig (1998) were uncertain whether the species is rhizomatous or not, but further collections reveal it is cespitose, although its stems may be buried and elongated when rooted in thatch of wet meadows (vegas).

Known specimens of ***Poa mendocina*** from Argentina and Chile: **ARGENTINA. Mendoza:** Department of San Rafael, district of El Sosneado, cerro Volcán Overo, [ca. 34°36'21"S, 70°04'48"W], 3100 m, en la última vega alta, sobre el aqua entre cojines de musgos, frecuente, 10 Feb 1955, *A. Ruiz Leal 16894* (HOLOTYPE: MERL; ISOTYPES: BAA!, SI); Department of Las Heras, Cerro Pelado, [ca. 32°47'S, 69°09'15"W], 3000 m, formando matas compactas, 19 Dec 1954, *A. Ruiz Leal 16456* (PARATYPE: MERL); Department of Malargue, Río Salado headwaters, lago on northwest flank of Cerro Torrecillas, ca. 6 km northwest of Las Leñas, 35°06'44"S, 70°07'39.6"W, 3075 m, wet meadow and rocky slopes, 6 Mar 2006, *P.M. Peterson, R.J. Soreng, D.L. Salariato & A.M. Panizza 19202* (SI!, US!). **CHILE. Región Metropolitana de Santiago:** Cajón del Maipo, Hito Paso Internacional Maipo, [ca. 34°11'31"S, 69°49'55"W], 3325 m, 17 Feb 1995, *C. Villagrán, R. Villa & F. Hinojosa 8484* (SGO!).

Poa hachadoensis Nicora.—A second set of specimens that RJS thought might represent two new species are attributable to two varieties of *Poa hachadoensis*. Nicora (1977, 1978) reported *P. hachadoensis* var. *hachadoensis*, from Chile, Región of Bio-Bío, Las Lajas, along with three specimens in Argentina, Province of Neuquén, Departments of Picunches and Aluminé, and illustrated it. In 2002 *R.J. & N. Soreng* collected this variety in the regions of Araucanía and Bio-Bío, in Chile, and in 2006 we collected this variety in the same Departments of Neuquén, Argentina, as cited by Nicora (1977, 1978).

Nicora (1977, 1978) reported *P. hachadoensis* var. *pilosa* from Argentina, Province of Neuquén, Departments of Minas, Lácar, and Province of Chubut, Departments of Río Senguerr and Futaleufú. Three old collections by *F.W. Pennell* from Chile, Región Libertador General Bernardo O'Higgins, from the vicinity of Sewell, belong to *P. hachadoensis* var. *pilosa*. These represent the only known locations for the species in Chile. In 2006 Peterson et al. made the first collection of this variety in the province of Mendoza, Argentina.

Poa hachadoensis vars. *pilosa* and *hachadoensis* have curious distributions. The range of *P. hachadoensis* var. *pilosa* extends for 1300 km from 34° to 46° S latitude along the Andes. The range of *P. hachadoensis* var. *hachadoensis* covers 220 km north to south in the middle of the range of *P. hachadoensis* var. *pilosa* (which has three allopatric stations to the north and four to the south of the typical variety), where the latter variety appears to be absent. The two varieties have not been collected together. Both varieties have a distinct dorsal tuft of wooly hairs on the callus. *Poa hachadoensis* var. *pilosa* has hairs along lemma keel and marginal veins, whereas the typical variety has glabrous lemmas. After viewing a series of collections and finding no other characteristics to satisfactorily divide them, we are not inclined to separate them at the species rank. However, because they are geographically isolated, they appear to warrant subspecific status. Both varieties occur in mossy waterlogged habitats in meadows in Aurucaria forests to lower alpine.

Poa hachadoensis var. ***hachadoensis*** new collections from Argentina and all vouchers for Chile: **ARGENTINA. Neuquén:** Picunches, 2 km E of Paso Pino Hachado, 38°39'41.3"S, 70°53'19.8"W, 1800 m, open, wet meadows with *Carex*, *Cortaderia*, and *Festuca*, 4 Feb 2003, *P.M. Peterson, R.J. Soreng & N.F. Refulio-Rodriguez 17466* (SI!, US!); Aluminé, 19 km S of Moquehue on highway 11 towards Lago Norquinco, 39°05'2.7"S, 71°19'41.3"W, 1050 m, meadow with *Juncus*, *Carex*, and scattered *Escallonia* on slopes with *Araucaria araucana* and *Nothofagus antarctica*, 3 Feb 2003, *P.M. Peterson, R.J. Soreng & N.F. Refulio-Rodriguez 17409* (SI!, US!); other collections from Argentina are cited by Nicora (1977, 1978). **CHILE.** [without other location] in "02/03/1939", *A. Burkart, 9510* (SI!); **Region VIII:** Bio-Bío, La Laja, [ca. 37°27'S, 71°19'W], *A. Burkart 27449* (SI, BAA); Parque Nacional Laguna Laja, southeast slope of Volcán Antuco, Estero el Aguado o del Volcán, above Vado, below a lone *Araucaria*, east of Los Angeles ca. 90 km, 37°27'43"S, 71°19'05"W, 1430 m, broad, nearly treeless, volcanic valley, scattered along creek bead in wet cobbly muck, 21 Jan 2002, *R.J. Soreng & N.L. Soreng 7177* (US!, CONC!); **Region IX:** Araucanía, west entrance to Parque Nacional Conguillio, east end of Laguna Captrén, in valley between Volcán Llaima and Sierra Nevada, east of Temuco ca. 70 km, 38°38'22"S, 71°41'49"W, 1284 m, wet grassy, mossy meadow at upper end of the lake surrounded by old *Araucaria araucana–Nothofagus betuloides* forest, common in the open meadow, 22 Jan 2002, *R.J. Soreng & N.L. Soreng 7192* (US!, CONC!).

Poa hachadoensis var. ***pilosa***, a new collection in Argentina and all vouchers for Chile. **ARGENTINA. Mendoza**: Department of Malargue, Andes, Rio Salado headwaters, Valle de Las Leñas, ca. 36 km northwest of Las Leñas on Highway 222, northwest of Malargue 65 km, 35°05'41.7"S, 70°08'10.6"W, 2740 m, grassy wet meadow with *Poa*, *Festuca*, and *Deschampsia*, 5 Mar 2006, *P. M. Peterson, R.J. Soreng, D.L. Salariato, A.M. Panizza 19188*, (SI!, US!); other collections from Argentina are cited by Nicora (1977, 1978). **CHILE. Region VI**: Libertador General Bernardo O'Higgins, Sewell ca. 34°04'S, 70°22'W, in 1925, *F.W. Pennell 12312* (SGO!), *12314* (SGO!), *12324* (US!).

One last collection turned up at CONC, SGO, and US that appears to actually be a new species. By the time

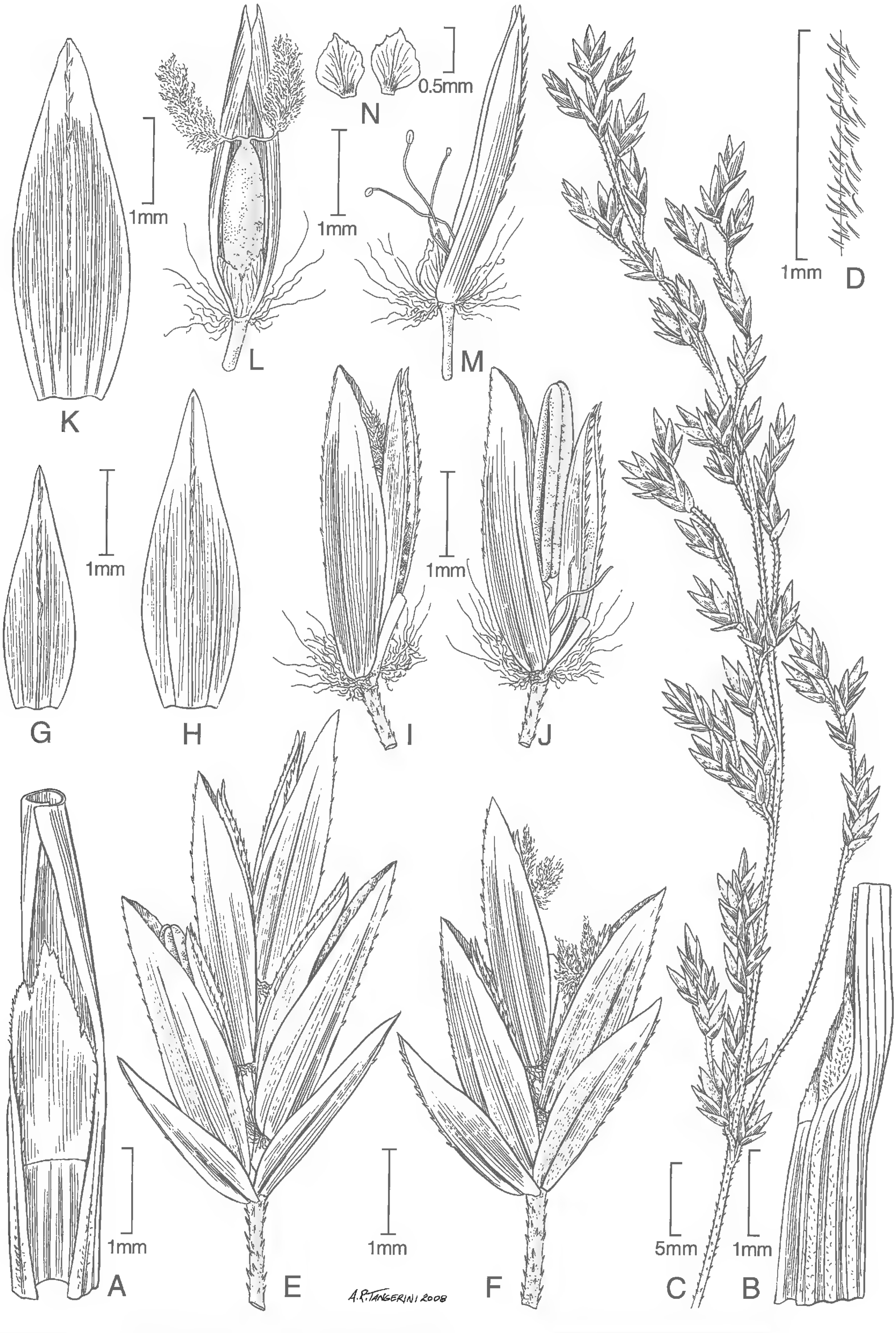
RJS realized this was new, it was too late in the growing season to effectively search for it, as it flowers in early November. A cursory search was made for it around the crossing of Río Renaico by Highway 5, southeast of Mininco. However, the grasses were in poor shape by the time we passed through the area in late January. The species is considered to be dioecious. The SGO specimen appears to have been pulled up as a clump, the staminate and pistillate panicles are not attached to a single base and may be from different individuals. The US sheet appeared to have two separate clumps, one of each sex (they have been separated and remounted on the holotype). In any case, the specimens are quite different from the other dioecious species of *Poa* in South America, all 22 members of which belong to *Poa* sect. *Dioicopoa* E. Desv. Unlike *Dioicopoa* species, the *Pfister* specimens have sparse to moderately congested, somewhat lax, slender panicles with slender branches that are naked in the lower 1/2, and the pistillate and staminate spikelets are undifferentiated in size, form, floret number, and pubescence. The lemmas are glabrous and the calluses have a well developed web, as in *Poa hachadoensis* var. *hachadoensis*, but the anthers are 2–2.5 mm long. The blades are densely hispidulous-strigulose adaxially on and between the veins, as in *Poa* sect. *Madropoa* Soreng subsect. *Madropoa* Soreng and subsect. *Epiles* Soreng (seven and five spp. respectively, in North America, Soreng 2007). The new species is tentatively placed in *Poa* subsect. *Madropoa* where it most closely resembles *Poa diaboli* Soreng & D.J. Keil, a rare species of the California Floristic Province (Soreng & Keil 2004). If *Poa pfisteri* is confirmed to belong to one of the above *Madropoa* subsections it would be the only occurrence of any species of either of these anywhere south of the state of Durango, Mexico. The infrageneric relationships of some or all native gynomonoecious species of South American *Poa* may be with "*Poa nervosa*" complex of *Poa* sect. *Madropoa* (eight spp. of North America; Soreng 2007; Soreng & Keil 2003), but this needs further study. Curiously, there is only one species of *Poa* sect. *Dioicopoa* in North America (Soreng 2007), *Poa arachnifera* Torr., nearly all species of which have tightly contracted panicles with crowded spikelets, and none have hispidulous-strigulose adaxial leaf surfaces.

The new species is here named for the collector, Don Augusto Pfister, who collected in Chile from 1941 to 1945 (according to Harvard University Herbaria, Index of Botanists, Index Herbariorum - Collectors, http://asaweb.huh.harvard.edu:8080/databases/botanist_index.html [accessed May 2008]), but from 1932 to 1964 (according to CONC herbarium records database; Clodomiro Marticorena, pers. comm.). There are 5080 sheets collected by Pfister in CONC, with duplicates in SGO, and US (at least for grasses). Pfister collected plants in all regions of Chile, with the majority coming from around the Termas de Chillán, in the Region of Bio-Bío, where he frequently bathed to alleviate his rheumatoid arthritis (Clodomiro Marticorena, pers. comm.).

Poa pfisteri Soreng, sp. nov. (**Figs. 1a–n; 2**). TYPE: CHILE. REGION XIII: Bio-Bío, Province of Santa Barbara, Puente Mininco, 1 Nov 1943, *A. Pfister s.n.* (HOLOTYPE (pistillate and staminate plants): US-2150300!; ISOTYPES (pistillate and staminate plants): CONC-6191!, SGO-73895!).

A *Poa diaboli* Soreng & D.J. Keil plantis dioeciis? (versus sequente gynomonoeciis), surculo sterili tantum extravaginali (versus extravaginali et intravaginali), vaginis conatis 1/5–1/2 (versus 2/5–7/10), laminis caulis 0.8–1.4 mm latis (versus 1.5–2.4 mm), conduplicatis cum marginis involutis (versus planis), laminis supremis plus redactis quam laminis subtendis (versus subaequalibus), ramis paniculis 2–3 pro nodo (versus 1–2), tereter vel leviter angulatis (versus valde angulosis), uncis parvis paucum differentiatis supra vel apud angulos obtusos (versus manifeste longioribus et accumulatis supra distinctos angulos), flosculis plerumque 3 vel interdum 4 [versus 3–6(–7)], rachillis internodalibus laevibus (versus leviter vel dense grosse scabris vel infrequenter laevibus), glumis primis 2–3 mm longis [versus (2–)2.7–3.8 mm], 1-nervis (versus 3-nervis), calli pili origine magis apud dorsum concentrata (verus diffusa), lemmatis superficiebus laevibus vel sparsim scabris apud apicem (versus raro vel dense, vel infrequenter sparsim scabris omnino), palearum carinis sparsim scabris (versus dense scabris supra carinos), laevibus intra carinos (versus scabris), differt.

Plants perennial; dioecious (?); short rhizomatous and stoloniferous, loosely tufted, tillers extravaginal. Culms 45–50 cm tall, 0.5–0.8 mm diam, geniculate above, slender, bases erect, frequently branching above the base, terete; nodes terete, 1 exerted in distal 1/2–1/3 of culm. Leaf sheaths, uppermost closed 1/5–1/2 their length, weakly keeled, moderately to densely scabrous distally, sometimes lightly strigulose distally, basal sheaths becoming gray-brown, fibrous, bases scabrous, glabrous, distal sheaths 2–3 times longer than their blades; collars slightly thickened; ligules (0.2–)0.5–2.5 mm long, uppermost 1.5–2.8 mm long; lower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A.P.TANGERINI 2008
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Fig. 1. *Poa pfisteri* Soreng [*A. Pfister 6191* (US-2150300)]. **A.** Ligule, adaxial view. **B.** Ligule and collar, lateral view. **C.** Pistillate inflorescence. **D.** Leaf blade, adaxial surface. **E.** Staminate spikelet. **F.** Pistillate spikelet. **G.** Lower glume. **H.** Upper glume. **I.** Pistillate floret, lateral view. **J.** Staminate floret, lateral view. **K.** Lemma. **L.** Pistillate flower, dorsal view (staminodes not shown). **M.** Palea and staminodes in pistillate flower, lateral view. **N.** Lodicules.

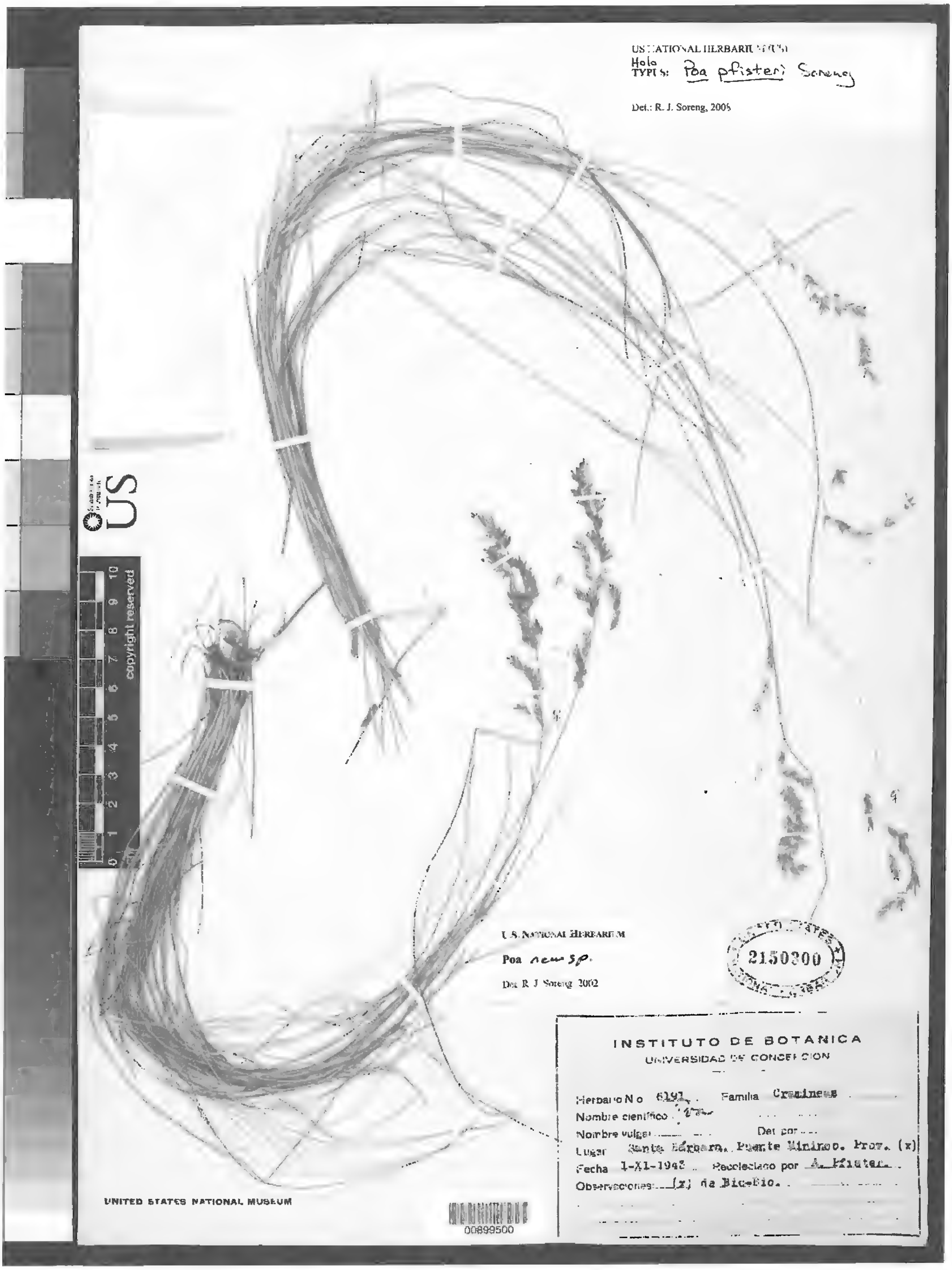
US NATIONAL HERBARIUM (US)
Holo TYPUS: Poa pfisteri Soreng
Det.: R. J. Soreng, 2005
US
copyright reserved
0 1 2 3 4 5 6 7 8 9 10
U.S. NATIONAL HERBARIUM
Poa new sp.
Det. R. J. Soreng 2002
2150300
INSTITUTO DE BOTANICA
UNIVERSIDAD DE CONCEPCION
Herbario N o 6191 Familia Gramineas
Nombre científico
Nombre vulgar Det por
Lugar Santa Bárbara. Puente Mininco. Prov. (x)
Fecha 1-XI-1942 Recolectado por A. Pfister
Observaciones: (x) de Bio-Bio.
UNITED STATES NATIONAL MUSEUM
00899500

Fig. 2. *Poa pfisteri* Soreng, holotype, *A. Pfister 6191* (US-2150300). The upper tuft is staminate (one pistillate inflorescence is not attached to this tuft but is mixed in with the staminate inflorescences). The lower tuft is pistillate.

ligules abaxially densely scabrous, apices obtuse or truncate; upper ligules abaxially smooth or sparsely scabrous, apices acute, erose; sterile shoot blades to 25 cm long, involute with tightly enrolled margins, abaxially smooth or very sparsely scabrous, adaxially densely hispidulous-strigulose on and between the veins, ligules of sterile shoots like those of the distal shoots of the culm; cauline blades 4–8 cm long, 0.4–0.7 mm wide in side view, involute with tightly inrolled margins, thin, soft, abaxially veins prominent, smooth except for scabrous keel and margins, adaxially densely strigulose on and between veins, narrowly prow-tipped, mid-culm blades to 31 cm, uppermost 2.7–5.3 cm long, the longest on the culm. Panicles 4–11 cm long, lax, broadly lanceoloid, loosely contracted, sparse to loosely congested, with 10–90 spikelets, lower axis smooth, proximal internodes 1.5–2.8 cm long, with 2 or 3 branches per node; branches, the longest 2–3.5 cm long, loosely ascending, lax, capillary, terete to slightly angled, sparsely to moderately scabrous proximally, moderately to densely scabrous distally, with 3–9 spikelets these mostly loosely overlapping in the upper 1/2, pedicels commonly ca. 1 mm long, mostly shorter than their spikelets. Spikelets 5–6 mm long, to 3 times longer than wide, laterally compressed, staminate and pistillate spikelets undifferentiated; purplish at anthesis, florets (2–)3–4; rachilla internodes 0.5–1.5 mm long, visible from the side, smooth, glabrous; glumes, distinctly keeled, slightly unequal, keels smooth or sparsely scabrous, sometimes with a few hooks on the sides near the apex, margins with few hooks; lower glumes 2–3 mm long, 0.3–0.4 mm wide in side view, subulate, 1-veined; upper glumes 2.9–3.5 mm long, 0.4–0.5 mm long in side view, narrowly lanceolate, 3-veined; calluses with a slightly diffuse dorsally concentrated tuft of soft, wooly hairs about 1/3–3/4 the lemma in length; lemmas 3.8–4.5 mm long, 0.6–0.7 mm wide in side view, narrowly lanceolate, distinctly keeled, glabrous throughout, lightly scabrous along keel upper 1/2, smooth or lightly scabrous near the margins and apex, intermediate veins faint to moderately prominent, margins narrowly scarious, edges smooth or with a few hooks, glabrous, apices narrowly acute; paleas slightly shorter than lemmas, sparsely to moderately scabrous over the keels, in the distal 1/2, between keels smooth, glabrous; lodicules ca. 0.6 mm long, ovate, with a small lateral lobe; stamens three, anthers 2–2.5 mm long or vestigial in pistillate flowers (0.2–0.4 mm long); ovaries glabrous with two styles and stigmas, vestigial in staminate flowers. Caryopses 2 mm long (immature), fusoid, ventrally sulcate, glabrous, adhering to the palea. Chromosome number unknown.

Distribution and Habitat.—**CHILE. Region VIII:** Bio-Bío, Province of Santa Bárbara. Known only from the type collection in the central valley of Chile. The one collection is presumably from near the northern Región IX Araucanía border, from slopes along the Río Renaico and tributaries east of Mininco, roughly from 37°47'S, 72°48'W, where elevations range between 200 and 300 m. If the species is still extant, it likely occurs in the adjacent Región of Araucanía.

ANNOTATED KEY TO SPECIES OF *NICORAEPOA* AND *POA* (EXCEPT SECT. *DIOICOPOA* SPECIES) IN CHILE REGIONS COQUIMBO TO MAGALLANES

Accepted taxa also occur in Argentina unless stated to be "endemic to Chile." Introduced taxa are marked*. See *Poa* in *Catalogue of New World Grasses* for synonyms (Soreng et al. 2003, and on-line). Authors are not given for taxa in the key if the taxon was already discussed above.

1. Ligules 6–23 mm long, apex margins conspicuously lacerated, glabrous; plants without rhizomes, forming robust tussocks, (0.5–)1–2.5 m tall; panicles tightly contracted; florets slightly contorted, twisted, glabrous; lemmas with a stiff cusp or stout mucro up to 3 mm long; plants from islands (or possibly mainland coast of Straights of Magellan), bluffs by the coast on the farthest southern reaches of Tierra del Fuego, Magallanes (**P.** subgen. **Ochlopoa** sect. **Parodiochloa**) ______ **P. flabellata** (Lam.) Raspail

1. Ligules mostly 0.5–6 mm long, but if elongated, then apex not conspicuously lacerated; plants rhizomatous, or if non-rhizomatous, then mostly much less than 1 m tall; panicles tightly contracted to loose and open; florets not at all contorted and/or twisted, glabrous or pubescent; lemmas rarely cuspidate or mucronate, or awned, but if awned then the awn slender (but see also *P. darwiniana*); plants widespread.
   2. Leaf blades adaxially with multiple ridges and valleys on either side of the midrib, ribs broader than the valleys; ligule margins ciliolate to ciliate; callus hairs (when present) forming a crown surrounding

the base of the lemma, hairs straight or slightly sinuous; plants with stout rhizomes (**Nicoraepoa**).

3. Plants forming low spiny mats, culms to 20 cm tall; leaf blades bluish-white, tightly folded, rigid, apex sharply pointed and pungent; plants in moist, sub-saline ground interior Patagonia (Sierra Baguales), NE Última Esperanza, Magallanes **N. pugionifolia**

3. Plants not forming low spiny mats, culms usually over 20 cm tall; leaf blades green or bluish-white, flat or loosely folded, somewhat rigid to lax, apex sharply pointed, but not piercing; plants of wet coastal sub-saline to interior fresh water meadow and riparian habitats.

4. Plants with viviparous spikelets.

5. Inflorescences narrowly lanceolate, erect, branches erect; florets glabrous; plants of low elevations, generally in sub-saline coastal wetlands, Magallanes **N. robusta**

5. Inflorescences ovoid, somewhat nodding, branches usually lax, ascending; florets usually with at least a few hairs on the callus; plants mainly of SW sub-coastal and low interior regions in fresh water wetlands, Bio-Bío to northern Magallanes, rarely further south **N. chonotica**

4. Plants without viviparous spikelets.

6. Florets glabrous; plants of low elevations often near the coast, Magallanes **N. robusta**

6. Florets pubescent with at least well developed crown of hairs around the callus; plants widespread.

7. Ligules ciliate, cilia as long or longer than the membranous base; leaf blades soft, flat, short, mostly 2–6 cm long; plants from mossy vegas above treeline **N. subenervis**

8. Panicles 5–15 cm long, (0.5–)1–5 cm wide, contracted or mostly open; plants of Andean Valparaíso and Región Metropolitana **N. subenervis** subsp. **spegazziniana**

8. Panicles 3–6.5(–10) cm long, ca.0.5(–1) cm wide, contracted; plants of Patagonia (Sierra Baguales), NE Última Esperanza, Magallanes **N. subenervis** subsp. **subenervis**

7. Ligules ciliolate, the cilia much shorter than the membranous base; leaf blades firm, flat or folded, elongated, some generally well exceeding 6 cm long; plants from coastal to subalpine wet meadows.

9. Panicles contracted, 1–2 cm wide; lemmas acute to cuspidate or slender mucronate to awned, apex often with minute lateral lobes on the sides of the awn, glabrous and scabrous or weakly pubescent on the keel; glumes usually as long or longer than adjacent lemmas; plants from upper elevations from Bio-Bío to Los Ríos, infrequent southward to northern Aisén **N. andina**

9. Panicles loosely contracted to open, 2–15 cm wide; lemmas obtuse to acute, entire or mucronate, but apex without lateral lobes, glabrous and scabrous, or also pubescent on the keel and sides; glumes usually shorter than adjacent lemmas; plants from low to mid elevations from Bio-Bío to northern Magallanes, rarely further south **N. chonotica**

2. Leaf blades adaxially with two grooves only, one on either side of the midrib, ribs not prominent and broader than the intercostal regions; ligule margins smooth or scabrous or at most ciliolate; callus hairs absent or present, usually originating in dorsal tuft from below the keel of the lemma (sometimes with secondary tufts below the marginal veins), hairs plicate or woolly (web), less often forming a crown originating around the base of the lemma and then woolly or with hairs straight to slightly sinuous; plants with slender rhizomes, or without rhizomes (**Poa**).

10. Plants with viviparous spikelets; plants of Tierra del Fuego and southern Patagonia mountains, Los Lagos to Magallanes.

11. Plants with bulbous shoot bases; plants of disturbed ground, from northern Magallanes ***P. bulbosa** L. subsp. **vivipara** (Koeler) Arcang.

11. Plants without bulbous shoot bases; plants widespread (**Poa** subgen. **Poa** sect. **Dioicopoa**) **P. alopecurus** (Gaudich. ex Mirb.) Kunth subsp. **fuegiana** (Hook. f.) D.M. Moore & Dogg. plants of Aisén to southern Magallanes; **P. obvallata** Steud.—plants of rocky slopes from upper forest openings to above treeline, from southern Araucanía to northern Aisén.

10. Plants without viviparous spikelets (or rarely with them, but then of Maule and more northern regions); plants widespread.

12. Plants with unisexual flowers only; anthers in staminate plants 1.3–3(–4) mm long.

13. Panicles loosely flowered, loosely contracted, somewhat lax; branches slender, plainly exposed, naked in the lower 1/2; spikelets mostly 5–6 mm long; pubescence of staminate and pistillate florets undifferentiated, lemmas glabrous and calluses pubescent; callus with dorsally concentrated crinkled hairs; leaf blades adaxially hispidulous-strigulose pubescent costally and intercostally; plants of presumably of steep rocky slopes in sclerophyllous Patagonian forest openings, in the central valley in Bio-Bío and Araucanía **P. pfisteri**

13. Panicles densely flowered (often interrupted), contracted, erect; branches stout, often hidden by the spikelets, commonly flowered in the lower half; spikelets mostly 5–8 mm long; pubescence

of staminate and pistillate florets differentiated (staminate florets usually glabrous or very sparsely pubescent), or both lemmas and calluses glabrous throughout; leaf blades smooth scabrous adaxially, sometimes densely scabrous costally and intercostally; callus glabrous or pubescent with plicate, or crinkled hairs, from a tight dorsal tuft, and often from tufts below the marginal veins, or with a crown of fairly straight to slightly sinuous hairs (**Poa** subgen. **Poa** sect. **Dioicopoa**).

Species of this section are notoriously difficult to key out, and staminate plants commonly have glabrous or nearly glabrous lemmas and can only be keyed vegetatively (See Giussani 2000). It is not possible for us to write a satisfactory key for these until the Chilean species are better known. However, we provide accepted names for species that are known to occur in the region of Chile covered in this key, along with general distribution: **Poa alopecurus** (Gaudich. ex Mirb.) Kunth subsp. **alopecurus**—plants of mesic steppe and forest openings, Magallanes; **P. bonariensis** (Lam.) Kunth—This name has been commonly applied to specimens of *Dioicopoa* from central Chile, but most of this material seen by RJS was redetermined as *P. denudata, P. lanuginosa*, or *P. paposana*. Several CONC specimens from low to middle elevations in central Chile, originally determined as *P. bonariensis*, need further study. The species is common in the pampas of Argentina and it is expected as a waif in Chile; **P. cumingii**—plants of coastal dunes between Coquimbo and Los Lagos (northern Chiloé), endemic to Chile; **P. denudata** Steud.—plants of low elevation forest openings and coastal bluffs and cliffs, from the coast of Bio-Bío to Los Lagos extending to Argentina; **P. gayana** E. Desv.—plants of the openings in middle to upper forested to shrubby mountain slopes of the interior central Andes of Chile, Coquimbo to Bio-Bío (name possibly misapplied). This species is highly variable and perhaps represents a large hybrid zone between *P. holciformis* in the alpine and a rhizomatous species of lower elevations with a webbed callus, perhaps *P. lanuginosa;* **P. gayana × holciformis**—plants intermediate between these species are frequent and occur on rocky slopes from high to medium altitudes in the Andes, Coquimbo to Maule; **P. holciformis** J. Presl—plants of open treeless slopes in the high Andes, Coquimbo to Maule, expected on high dry slopes further south also; **P. lanuginosa** Poir.— the typical form with webbed calluses occurs from low elevations in the Central Valley to middle elevation forested slopes, Metropolitana to Aisén, and a form with glabrous calluses occurs in riparian meadows in Patagonian steppe, Magallanes; **P. obvallata** Steud.—plants of rocky open forest and alpine volcanic slopes in the Andes, Bio-Bío to Los Lagos; **P. paposana**—plants of rocky slopes in fog zones of coastal hills, Valparaíso to southern Antofagasta, endemic to Chile; **P. spiciformis** (Steud.) Hauman & Parodi var. **spiciformis**—plants of dry Patagonian steppe, Magallanes; **P. spiciformis** var. **iberi** (Phil.) Giussani—plants of dry Patagonian steppe, Magallanes.

12. Plants with some or all florets bisexual; developed anthers sometimes shorter, 0.2–3 mm long.

14. Anthers 0.2–1(–1.2) mm long.

15. Glumes exceeding or equaling the lower floret, similar in form and length; plants of ripaian meadows in Patagonian steppe, from Magallanes (*Dissanthelium* s.l.) ____ **P. atropidiformis** Hack.

16. Lemmas glabrous ____ **P. atropidiformis** var. **atropidiformis**

16. Lemmas pubescent ____ **P. atropidiformis** var. **patagonica** (Parodi) Nicora (This variety, known only from Argentina, is expected in Chile)

15. Glumes shorter than the lower floret, similar or unequal in form or length; plants widespread.

17. Plants annual (infrequently surviving more than one season); callus glabrous; palea keels softly pubescent, not at all scabrous; terminal florets within spikelets often pistillate; primarily of disturbed ground, coastal to above treeline (**Poa** subgen. **Ochlopoa** sect. **Micrantherae**).

18. Anthers 0.2–0.5 mm long; branches ascending, spikelets crowded along the branches; infrequent, distribution poorly documented, known from Valparaíso and Metropolitana ____ ***P. infirma** Kunth

18. Anthers 0.5–1.0 mm long; branches ascending to spreading, spikelets loosely arranged along the branches; plants common, widespread, of all Regions ____ ***P. annua** L.

17. Plants perennial (sometimes weakly so); callus glabrous or webbed; palea keels glabrous and scabrous, also sometimes softly pubescent medially; all florets bisexual.

19. Florets glabrous; lemmas and rachillas densely scabrous throughout, glabrous, lemma apexes with a short stiff scabrous mucro (**Poa** subgen. and sect. uncertain, possibly sect. *Dasypoa*); plants of rocky coastal cliffs and slopes of the outermost islands of Tierra del Fuego, Magallanes (Cabo de Hornos) ____ **P. darwiniana** Parodi

19. Florets pubescent; lemmas and rachillas not densely scabrous throughout, glabrous or pubescent, lemma apexes without mucros; plants widespread.

20. Inflorescences congested, contracted, spikelets crowded; branches quite scabrous; lemmas pubescent between the veins; callus with a dorasl tuft of crinkled hairs, sometimes with secondary tufts below the marginal veins; plants of disturbed ground in upper forested to subalpine shrub zones, from Mexico to Tierra del Fuego, Arica & Parinacota to Magalanes in Chile (**Poa** subgen. **Poa** sect. **Dasypoa**) ________ **P. scaberula**
20. Inflorescences open or contracted, spikelets not crowded; branches smooth; lemmas glabrous between the veins; callus with a dorsal tuft of crinkled hairs or glabrous, secondary tufts absent; plants of more stable habitats, from Metropolitana to Araucanía (**Poa** subgen. **Poa** sect. **Homalopoa** s.l.).
    21. Culms 4–20 cm tall; inflorescences contracted, ca. 0.5 mm wide, slightly spreading in anthesis to 1 cm wide; plants of high wet meadows and slopes in the central Andes, from Metropolitana ________ **P. mendocino**
    21. Culms 15–60 cm tall; inflorescences open, 2–5 cm wide; plants of wet mossy meadows and slopes in forest openings to low alpine regions, from Liberator General O'Higgins to Araucanía ________ **P. hachadoensis**
        22. Lemmas glabrous; plants of Bio-Bío to Araucanía________ **P. hachadoensis** var. **hachadoensis**
        22. Lemmas pubescent; plants of Liberator General O'Higgins ________ **P. hachadoensis** var. **pilosa**

14. Anthers 1.3–3(–4) mm long.
    23. Florets glabrous; blades flat, apexes abruptly naviculate; plants of wet meadows in the central Andes, from Valparaíso to Metropolitana________**P. acinaciphylla** E. Desv.
    This taxon possibly originated from past intersectional hybridization between **P.** subgen. **Poa** sect. **Acutifoliae**; **P.** subgen. **Poa** sect. **Dioicopoa**; *P. planifolia* × *P. holciformis.*
    23. Florets pubescent; blades flat, folded, or involute, apexes tapered or naviculate; plants in various habitats, widespread.
        24. Blades 5–10 mm wide, prominently keeled, flat to tightly folded, apex abruptly attenuated, acuminate, and pungent; florets pubescent; lemmas thin and lustrous, usually sparsely short pubescent along the keel; callus with a dorsal tuft of woolly hairs (webbed); plants of wet subsaline to freshwater meadows, springs, and stream-sides above tree line in the central Andes, from Valparaíso to Metropolitana (**Poa** subgen. **Poa** sect. **Acutifoliae)**________ **P. planifolia**
        24. Blades 1–5(–7) mm wide, not prominently keeled, flat to folded, apex obtuse to acute, not pungent; florets glabrous or pubescent; lemmas dull (not reflective) or at least not especially thin and lustrous, glabrous or pubescent; callus glabrous or pubescent; plants of various habitats and distributions.
            25. Lemmas pubescent only on the keel, or also sparsely so on the lower 1/4 of the marginal veins, intermediate veins pronounced; first glumes 1-nerved, often sickle-shaped; ligules acuminate; callus with a well developed dorsal tuft of wooly hairs (webbed); plants of disturbed ground in forested zones, known from Valparaíso south to Magallanes (**Poa** [subgen. **Ochlopoa** × **Stenopoa**] sect. **Pandemos**) ________ ***P. trivialis** L. subsp. **trivialis**
            25. Lemmas pubescent on the keel and marginal veins and sometimes on intermediate veins and sometimes between the veins, intermediate veins faint to pronounced; first glumes (1)3-nerved, rarely sickle-shaped; ligules truncate to acuminate; callus glabrous or pubescent with a web or crown of hairs; plants widespread and of various distributions.
                26. Sheaths compressed-keeled; panicles open; plants wet to mesic meadows, thickets, and open forests, from Tierra del Fuego to northern Magallanes, but likely in Aisén also (**Poa** subgen. **Poa** sect. **Poa**) ________**P. yaganica** Speg.
                Poa ayseniensis, from Rio Aisén, is known only from the type. The original description does not adequately distinguish the this taxon from *P. yaganica*, a species similar to *P. pratensis*, with a web, but with more compressed sheaths, more rounded to acute ligule apexes, and longer glumes.
                26. Sheaths not noticeably compressed-keeled; panicles contracted or open.
                    27. Plants rhizomatous, spreading; upper culm sheaths closed more than 1/4–2/5 the length; lemmas glabrous between the veins; callus with a

well developed dorsal web of crinkled hairs (**Poa** subgen. **Poa** sect. **Poa**) __________ **P. pratensis** L.

Poa pratensis subsp. **alpigena** (Lindm.) Hiitonen has lemmas with glabrous or sparingly pubescent intermediate veins, narrowly ovate spikelets, narrowly pyramidal inflorescences with mostly smooth branches, and only extravaginal shoots. It is apparently indigenous in the Magallanes Region as a disjunct taxon from northern hemisphere boreal regions. Introduced **P. pratensis* s.l. is known from disturbed ground from Coquimbo to Magallanes, but its races have not been sorted out taxonomically in Chile. The lemmas are glabrous between the keel and marginal veins, spikelets more ovate, inflorescences pyramidal with smooth or scabrous branches, and some shoots usually intravaginal.

27. Plants without rhizomes, strictly tufted; upper culm sheaths closed 1/10–1/5 the length; lemmas sometimes pubescent between the veins; callus glabrous or with a crown of hairs or with a dorsal web of crinkled hairs.
    28. Callus with a crown of hairs 0.2–2.0 mm long around the base of the lemma (**Poa** subgen. **Stenopoa** sect. **Secundae**).
        29. Lemmas weakly keeled, pubescent on and between the veins at least at the base, pubescence of the keel and between veins little differentiated; panicles secund, contracted to loosely contracted, much longer than wide (except when somewhat open in anthesis); plants of subalpine to lower alpine open slopes, from Valparaíso to Magallanes __________ **P. secunda** J. Presl. subsp. **secunda**
        29. Lemmas distinctly keeled, sometimes glabrous between the veins, but if pubescent between the veins present, then hairs distinctly longer on the keel than between the veins; panicles loosely contracted to open, nodding and about as long as wide; plants of subalpine open slopes, from Bio-Bío to Magallanes __________ **P. stenantha** Trin. var. **stenantha**
    28. Callus glabrous or with a dorsal web at the base of the keel of the lemma.
        30. Upper culm node in the lower 1/3 of the culm; upper culm leaf blades distinctly shorter than the upper sheath; lemmas with at least a few hairs between the keel and marginal veins near the base or on the intermediate veins; callus glabrous or webbed.
            31. Spikelets (3.8–)4–5 times as long as wide (when closed); lemmas weakly keeled, pubescent on the keel and marginal veins and between the veins at least near the base, the hairs about the same length between the veins and those on the keel and marginal veins; callus glabrous; plants of subalpine to lower alpine open slopes, from Valparaíso to Magallanes (**Poa** subgen. **Stenopoa** sect. **Secundae**) __________ **P. secunda** subsp. **secunda**
            31. Spikelets 2–3 times as long as wide (when closed); lemma distinctly keeled, pubescent between the veins at least near the base or not, sometimes pubescent on the keel and marginal veins only, or on these and the lateral veins only, the hairs shorter between the veins than those on the keel and marginal veins; callus glabrous or webbed; plants of subalpine open slopes, from Aisén to Magallanes (**Poa** subgen. **Stenopoa** sect. **Stenopoa**) __________ **P. glauca** Vahl subsp. **glauca**
        30. Upper culm node in the middle to upper 1/3 of the culm; upper culm leaf blades subequal or longer than the upper sheath; lemmas glabrous between the keel and marginal veins; cal-

lus webbed; plants introduced (**Poa** subgen. **Stenopoa** sect. **Stenopoa**).

32. Ligules 0.2–1 mm long, apex truncate; web sparsely developed, usually less than 1/2 the lemma in length (when stretched out); rachilla usually softly puberulent; plants of mesic forest margins, known from Magallanes________________ ***P. nemoralis** L.
32. Ligules 1–4 mm long, apex obtuse to acute; web moderately well developed, usually more than 1/2 the lemma in length (when stretched out); rachilla glabrous with minute bumps or sparsely hispidulous; plants usually of riparian meadows, known from Magallanes ________________ ***P. palustris** L.

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BOOK REVIEW

Bill and Jan Moeller. 2000 (2nd printing). **Lewis & Clark: A Photographic Journey.** (ISBN 0-87842-405-9, pbk.). Mountain Press Publishing Company, P.O. Box 2399, Missoula, Montana 59806, U.S.A. (**Orders:** www.mountain-press.com, info@mtnpress.com, 1-800-234-5308, 406-728-1900). $18.00, 107 pp., 77 color photographs, 1 map of Lewis and Clark route, 8 3/8" × 9".

By the nineteenth century the newly formed republic of the United States of America was eager to find a commercial route via a northwest passage to the Pacific Ocean. The impediment was the vast wilderness between the Mississippi River and the Rocky Mountains, nearly 830,000 square miles (2,147,000 km) AND it was owned by the French government, a realpolitik of both nature and man for the new republic. Fortunately for the United States, Napoleon was in the mood to sell having depleted the French treasury for his military operations. Over fifteen million dollars was paid to the French, and the Louisiana territory was now in the hands of the United States, more than doubling its size. In 1803 President Thomas Jefferson would give his long dreamed of expedition the distinct name of *Code of Discovery,* but history would remember it as the Lewis & Clark expedition. With $2,500 allocated by Congress, Jefferson set out the directives of the expedition:

> *"The object of [the] mission is to explore the Missouri River, and such principal stream of it, as, by its course and communication with the waters of the Pacific Ocean, may offer the most direct and practicable water communication across the continent, for the purpose of commerce."*

His personal secretary, 29-year-old Meriwether Lewis would be in command of the expedition and take charge of the natural sciences: collect specimens of flora and fauna, and determine soil and mineral types. In addition, he would document the various Indian tribes along with their habits, clothing, dwellings, occupations, tools, and religions. 33-year-old William Clark would be his co-commander. Having served on the western frontier, Clark would take charge of engineering and geography. He would establish latitudes/longitudes and climatic information along the entire expedition. Both were charged with treating all the Indian tribes with respect while promoting commercial intercourse. Along the way they would meet a French Canadian trapper and his Shoshoni wife, Sacagawea, who would play a vital role in Indian relations with the various tribes.

It took two years, four months, and 10 days to complete the round-trip of 8,000 miles. The original cost allotted by congress: $2,500. The final cost was $38,722.25. Although over budget (some things never change) and not finding a navigable water route to the Pacific as hoped, the expedition would contribute enormously to the expansion of the American west by mapping many lands and waterways of the northwestern. The expedition also returned a wealth of material on the flora and fauna of the territory. Lewis and Clark stayed true to their directive to establish good relationships with most of the Indian tribes they encountered (much of this can be attributed to Sacagawea and good fortune).

A bit like Lewis and Clark themselves, authors Bill and Jan Moeller have taken their photographic talents, love of travel and the outdoors, along with tireless research, to create a fine series of books that are photographic histories, biographies, and journeys. *Lewis & Clark, A Photographic Journey* is their fifth such book. This kind of book (a photographic treatise) is not just researched from an armchair in front of a computer. It takes hitting the road in an RV and traveling the paths that Lewis and Clark made over 200 years ago. Except this time, the task is finding and then gaining permission to access locations, and working out the logistics of photographing each stage of the expedition. The photographs are stunning showing the route as the expedition traveled it with consecutive dates and wonderful quotes throughout the book gleaned from the journals of both Clark and Lewis. It makes one feel as though one is reading the journals and seeing what Lewis and Clark must have seen for the first time:

> May 13, 1805, Friday, (The Missouri Breaks—in what would be Montana):
> *"The hills and river cliffs which we passed today exhibit a most romantic appearance, The bluffs of the river rise to the height of from 200 to 300 feet and in most places nearly perpendicular, they are formed of remarkable white sandstone...."*—Lewis
>
> Sept. 14-15, 1805, through the Bitterroot Mountains, the worst terrain they had experienced, elevation 7,000 ft and higher, eventually so exhausted and hungry they resort to eating two of their horses:
> *"I have been wet and as cold in every part as I ever was in my life...."*—Clark

My only regret is that the reference map is far too basic to accompany such well-done text and beautiful photography. It would have been a more enjoyable and educational experience to have had a more detailed map labeling the progression and events related to the journey.—*Linny Heagy, Linny/Designer, Illustrator, email: a0005835@airmail.net.*

LEPTOCHLOA (POACEAE: CHLORIDOIDEAE) IN COLOMBIA

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ABSTRACT

A taxonomic summary is presented for the Colombian species of *Leptochloa*. The classification, nomenclature, generic affinities, and morphological variation of the genus are discussed. *Leptochloa* is represented in Colombia by six species and one nontypical subspecies. Keys to recognize Colombian species are given, as well descriptions of the species, illustrations, geographical distributions, and morphological and ecological observations. The basionym *Chloris dubia* Kunth is lectotypified.

RESUMEN

Se presenta un estudio taxonómico de las especies colombianas del género *Leptochloa*. Se analizan diversos aspectos relativos a la clasificación, la nomenclatura, las afinidades genéricas y la variación morfológica de los caracteres. El género *Leptochloa* está representado en Colombia por seis especies y una subespecie. Se presentan las claves para reconocer las especies presentes en Colombia, así como las descripciones de éstas, la iconografía, la distribución geográfica y se comentan algunas observaciones morfológicas y ecológicas. Se lectotipifica el nombre *Chloris dubia* Kunth.

Leptochloa P. Beauv., sensu lato (including *Diplachne* P. Beauv.) is a genus of approximately 32 annual or perennial species (Snow 1997). The native range of the genus is pantropical into warmer temperate regions, with several species being weedy and widely distributed. Although Parodi (1927), McNeill (1979), Phillips (1982), Nicora and Rúgolo de Agrasar (1987), and Nicora (1995) recognized *Diplachne* as a separate genus, we agree with McVaugh (1983), Clayton and Renvoize (1986), Nowack (1994), Renvoize (1998), and Snow (1997, 1998a) that the number of florets, the size of the spikelets, shape of the caryopsis, arrangement of spikelets on the panicle branches (i.e., secund or not secund), and other morphological characters intergrade strongly and are unable to support generic separation (Snow 1997). Moreover, based on a numerical analysis of morphological characters, Phillips (1982) found that species placed in *Diplachne* and *Leptochloa* overlapped one another in a principal coordinates scatter plot. Although it is likely (next paragraph) that some elements of *Leptochloa* may need to be segregated in the future with further analyses, in our opinion it is unlikely that such a generic segregate would correspond closely to *Diplachne* as recognized by the authors cited above. Thus at this time it seems more appropriate to recognize *Leptochloa* in its broad sense (Peterson et al. 1997; Snow 1997).

The monophyly of *Leptochloa* sensu lato was not supported when tested cladistically with morphological and anatomical data, depending on the number of outgroups included (Snow 1997). Moreover, its monophyly has not been tested in breadth using molecular data, and the relationship of *Leptochloa* with other genera is far from certain (Columbus et al. 2007; Peterson et al. 1997, 2007). For example, in a restriction fragment analysis of cpDNA using a few representatives of New World genera (Duvall et al. 1994), *Leptochloa* [*L. dubia* (Kunth) Nees] was a member of a basal clade, sharing a common ancestor with *Scleropogon* Phil., *Dasyochloa*

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Willd. ex Rydb., *Munroa* Torr., and *Erioneuron* Nash. In a strict consensus tree with bootstrap analysis, species of *Leptochloa* did not form a particularly strong clade with the other genera, and instead shared a common ancestor in a clade that included the Muhlenbergiinae, Munroinae, *Scleropogon*, *Sporobolus* R. Br., *Eleusine* Gaertn., *Tridens* Roem. & Schult., *Tripogon* Roem. & Schult., and *Eustachys* Desv. (Duvall et al. 1994). In a phylogenetic study of Chloridoideae based on *matK* sequences, *Leptochloa* (*L. dubia*) formed a clade with *Coelachyrum* Hochst. & Nees, and *Astrebla* F. Muell. emerged as sister to these (Hilu & Alice 2001). Other genera in the C_1 clade of Hilu and Alice (2001) included *Brachyachne* (Benth.,) Stapf, *Chloris* Sw., *Cynodon* Rich., *Dinebra* Jacq., *Eleusine*, *Enteropogon* Nees, *Eustachys* Desv., *Lepturus* R. Br., *Lintonia* Stapf, *Microchloa* R. Br., *Oxychloris* Lazarides, *Tetrapogon* Desf., and *Trichloris* E. Fourn. & Benth. In another phylogenetic study of Chloridoideae based on analysis of combined *trnL–F* and ITS sequences, the placement of species of *Leptochloa* [*L. dubia*, *L. fusca* (L.) Kunth, and *L. panicea* (Retz.) Ohwi] in separate clades suggests a polyphyletic origin (Columbus et al. 2007). In a phylogenetic analysis of *rps16* sequences, *Leptochloa dubia* formed a clade with *Eleusine* [*E. coracana* (L.) Gaertn.], whereas in a tree based on analysis of *waxy* sequences, *Leptochloa* formed a clade with *Eleusine coracana* and *Dactyloctenium aegyptium* (L.) Willd. and *D. radulans* (R. Br.) P. Beauv. (Ingram & Doyle 2007). In summary, the monophyly of *Leptochloa* has not been corroborated with molecular data, and phylogenetic relationships of *Leptochloa* with other genera remain obscure (Columbus et al. 2007, Peterson et al. 2007). For these reasons Peterson et al. (2007) treated the genus as *incertae sedis* within the tribe Cynodonteae.

Leptochloa is represented by 17 species in the New World (13 of these native), six of which occur in Colombia (Peñaloza-Jiménez et al. 2002; Peterson et al. 2001, 2007). Our taxonomic treatment contains keys for determining the species, descriptions, distributions, specimens studied, illustrations, and synonymies. Only synonyms used frequently in Colombian literature are given. For further synonymy see Snow (1997), Peterson et al. (2001), and Soreng et al. (2008). This study is based on the examination of herbarium specimens from COAH, CAUP, COL, HUA, MO, and US, including the type specimens of most species studied. The present study aims to contribute to the knowledge of the Colombian grasses by collaborating with the Biodiversity Program and Colombian Flora Inventories.

Leptochloa P. Beauv., Ess. Agrostogr. 71. 1812. Type: *Leptochloa virgata* (L.) P. Beauv.

Plants annual or perennial; caespitose, lacking stolons and rhizomes but sometimes geniculate and rooting at the lower nodes in mesic habitats. Flowering culms 30–150 cm tall, ascending to erect, glabrous to sometimes pilose, arising from fibrous roots. Leaves cauline; sheaths longer or shorter than internodes with smooth margins; ligules a membrane or a ciliate membrane; blades narrowly lanceolate to linear, flat, often inrolled on drying, not pungent. Inflorescence a panicle of spicate primary branches exserted (or lower branches occasionally inserted proximally) along an elongated main axis; main axis scabrous; primary branches spaced or sometimes subdigitate, ascending to spreading from main axis, terminating in a spikelet; glabrous or scabrous. Cleistogamous spikelets absent or present in axils of lower sheaths (in *L. dubia* or rarely in *L. fusca* subsp. *fascicularis*). Disarticulation above glumes, lemma and palea falling as a unit; callus glabrous to sparsely sericeous. Spikelets solitary, laterally compressed or terete, subsessile to shortly (<2 mm) pedicellate, distant but often imbricate, often secund; glumes shorter than spikelets, unequal, smooth, glabrous or slightly scabrous; lower glumes 1-veined; upper glumes shorter than lower lemma, 1–3-veined, unawned; rachilla pronounced between florets, glabrous; florets 2–13 per spikelet, sterile florets often present above fertile florets (and uppermost floret often reduced to small, awnless rudiment); lemma 3-veined (rarely 4–5-veined in *L. dubia* at base), membranous, smooth, glabrous or hairy along veins and sometimes between veins, apex entire, emarginate or lobed, awnless, mucronate, or awned; paleas glabrous to sericeous, unawned, membranous, margins not enfolding fruit, smooth; lodicules truncate; stamens 2 or 3; anthers yellow or reddish-purple; stigmas 2. Fruit with adnate pericarp (sometimes weakly so); caryopses dorsiventrally compressed or laterally compressed (Snow 1998a). Base chromosome number of $x = 10$.

Comments.—*Leptochloa* and *Diplachne* were established by Palisot de Beauvois (1812). *Leptochloa* was based on three species, while *Diplachne* was based on *D. fascicularis* (Lam.) P. Beauv. [= *L. fusca* (L.) Kunth subsp. *fascicularis* (Lam.) N. Snow]. *Leptochloa* was later lectotypified with *L. virgata* (L.) P. Beauv. by Nash (1913), which was ineffective according to Index Nominum Genericorum Art. 10.5 example 6. In addition, both genera were placed in the same "cohors," which suggested that Palisot de Beauvois regarded them as more or less closely related. In his "*Tabula Methodica*" he mentioned that the lemmas of *Diplachne* were shortly awned, whereas those of *Leptochloa* were said to be awnless. However, this feature varies considerably and the lemma of *Leptochloa* can be entire, emarginate, lobed, awned, mucronate, or unawned. The micromorphological characters of the lemma vary little in *Leptochloa* (Snow 1996), and with few exceptions, cork cells are present, silica cells are absent, chloridoid bicellular microhairs are present, prickles are present, and macrohairs are present. However, the occurrence of papillae on long cells and short cells is more variable, suggesting their presence or absence may be phylogenetically informative within the genus (Snow 1996).

Ecology and geographic distribution.—The native range of *Leptochloa* is nearly worldwide in warm-temperate to tropical regions. Its ecological distribution mostly includes semi-open vegetation such as grasslands. The species most frequently grow in periodically disturbed or seasonally saturated areas such as riparian corridors, ephemeral pools, or artificial impoundments, although *L. dubia* generally prefers well drained soils. All widespread annual species are considered weedy in agricultural situations (Snow 1997) and some have become established on continents far beyond their native range (Snow & Simon 1999; Snow 2004).

KEY TO THE SPECIES OF *LEPTOCHLOA* IN COLOMBIA

1. Sheaths sparsely to moderately pilose, the hairs papillose-based **L. panicea** subsp. **brachiata**
1. Sheaths glabrous to sparsely hairy, the hairs usually not papillose-based.
    2. Ligules membranous and neither ciliate nor erose (but sometimes lacerate), 5–8 mm long, apically attenuate **L. fusca**
    2. Ligules membranous and sometimes ciliate or erose apically, less than 5 mm long, apically obtuse or truncate.
        3. Plants perennial; ligules 0.2–1.5 mm long.
            4. Apex of lemma broad and usually notched; hidden inflorescences present in lower leaf sheaths; florets widely divergent (40–90°) from rachilla during anthesis **L. dubia**
            4. Apex of lemma acute, not notched but sometimes awned; hidden inflorescences absent in lower leaf sheaths; florets on slightly diverging from rachilla at anthesis (if at all) **L. virgata**
        3. Plants annual; ligules 2.2–3.8 long.
            5. Culms more or less round in cross section; panicle branches mostly somewhat stiff; lemmas 2.4–3 mm long; anthers 0.6–0.8 mm long **4. L. panicoides**
            5. Culms strongly compressed (especially lower internodes) in cross section; panicle branches flexuous to prominently arcuate; lemmas 2.1–2.4 mm long; anthers 0.2–0.4 mm long **5. L. scabra**

1. Leptochloa dubia (Kunth) Nees, Syll. Pl. Nov. 1:4. 1824. (**Fig. 1, A–C**). *Chloris dubia* Kunth, Nov. Gen. Sp. (quarto ed.) 1:169. 1816. *Leptostachys dubia* (Kunth) G. Mey., Prim. Fl. Esseq. 74. 1818. *Diplachne dubia* (Kunth) Scribn., Bull. Torrey Bot. Club. 10:30. 1883. *Rabdochloa dubia* (Nees) Kuntze ex Stuck., Anales Mus. Nac. Buenos Aires 11:121. 1904. *Sieglingia dubia* (Kunth) Kuntze ex Stuck., Anales Mus. Nac. Buenos Aires 11:128. 1904. TYPE: MÉXICO: *F. Humboldt & A. Bonpland 4172* (LECTOTYPE, here designated: P!; DUPLICATES OF LECTOTYPE: K, K-microfiche, US-865876 fragm. ex P!).

Perennials, mostly erect or infrequently decumbent or sprawling. Culms (5–)30–110 cm tall, 1.0–4.5 mm wide, unbranched or only as tillers from very base, round or flattened below; nodes glabrous, internodes 3–11 cm long, herbaceous, solid (or occasionally hollow by virtue of aging). Leaf sheaths longer or shorter than internodes, sparsely pilose, especially below, and occasionally pilose (sometimes densely so) near the collar, the hairs occasionally from papillose bases, the margins glabrous or somewhat pilose; collars green or tan; ligules mostly 1.0–1.5 mm long, membranous, truncate, ciliate apically; blades (2–)8–35 cm long, 2–8 mm wide, mostly linear or somewhat lanceolate, scabrous above at base or with a sparse covering of pilose hairs, glabrous to minutely scabrous below, flat but drying involute, midvein mostly prominent or sometimes not. Panicles of two types, the apical ones generally exserted at maturity and the lateral ones completely hidden in lower leaf sheaths; apical panicles 10–45 cm long, (2–)3–25 cm wide; the branches (2–)5–15, (1.5–)3–19 cm long, alternate or infrequently subdigitate, ascending to reflexed, often somewhat lax, minutely scabrous, the branch axils pilose or merely scabrous. Spikelets 4.0–12.0 mm long, imbricate

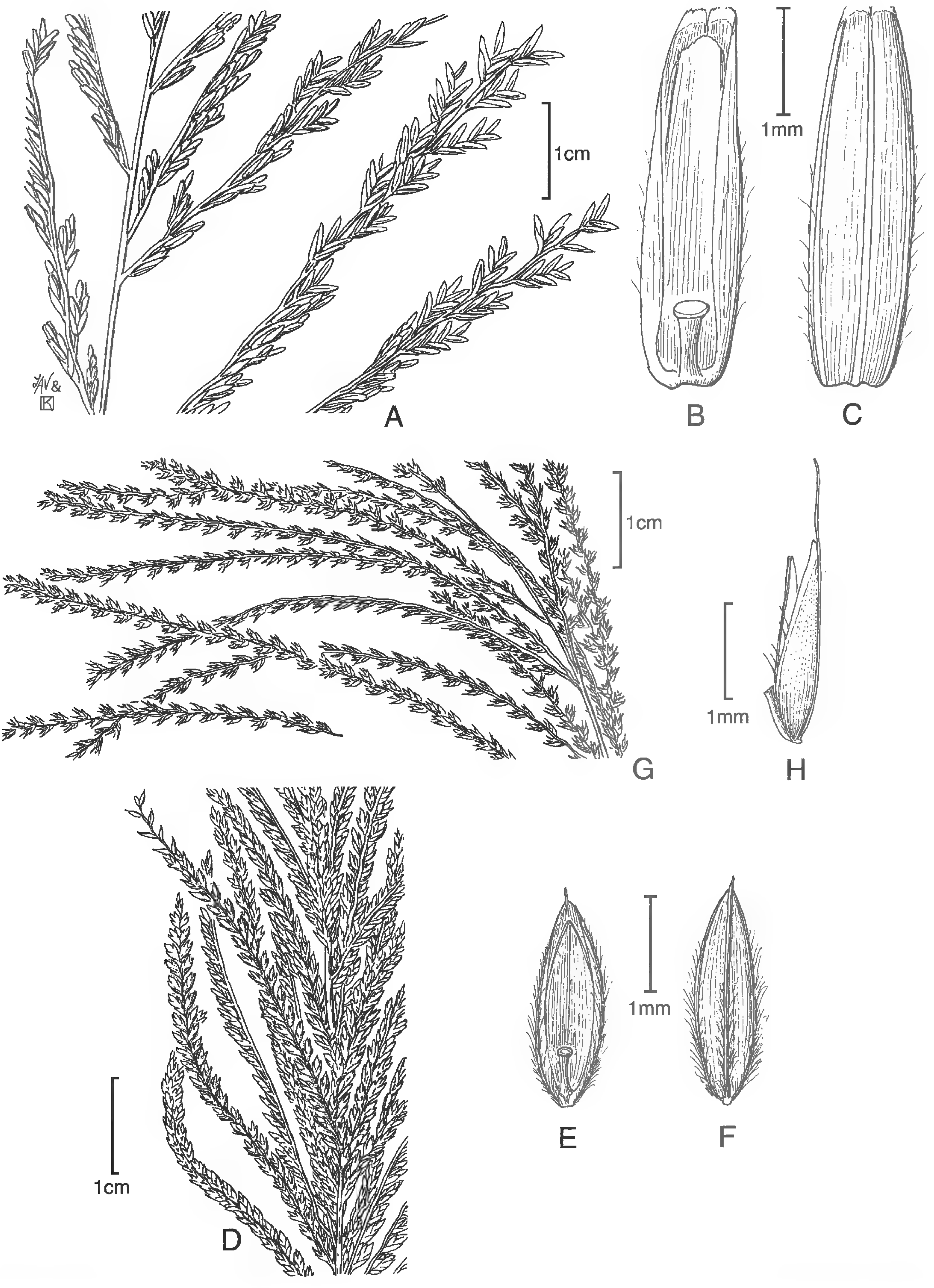

Fig. 1. *Leptochloa dubia*. **A.** Inflorescence. **B.** Floret with rachilla and palea enclosed by lemma (ventral view). **C.** Lemma. *Leptochloa scabra*. **D.** Inflorescence. **E.** Floret with rachilla and palea (ventral view). **F.** Lemma. *Leptochloa virgata*. **G.** Inflorescence. **H.** Floret with rachilla (lateral view).

to distant, mostly sessile; florets 4–13; callus glabrous or with a few short hairs; lower glumes (1.6–)2.3–4.8 mm long, membranous, narrowly triangular or ovate, scabrous along midvein, sometimes papillate on sides, acute; upper glumes 3.3–6.0 mm long, membranous, ovate to lanceolate, scabrous on midvein (and sometimes with 1 or 2 additional veins at least basally) and papillate on edges, acute; lemmas 3.5–5.0 mm long, membranous, ovate to obovate or widely obovate, light brown, bronze, light to very dark green, the lateral veins usually prominent but sometimes not so, sericeous at least along lower portions of lateral veins and sometimes on midvein and between veins, the apex usually bifid, broadly acute, obtuse, or truncate, awnless or mucronate; paleas subequal to lemma, lanceolate, membranous above but somewhat cartilaginous near base, distinctly ciliate on edges, sometimes sericeous between veins, apex acute; stamens 3; anthers (0.3–)1.0–1.6 mm long, yellow. Caryopses 1.5–2.3 mm long, 0.9–1.0 mm wide, narrowly elliptic, elliptic or very widely obovate in hilar profile, depressed obovate in transverse section, with a broad, shallow groove on hilar side, smooth, brown; pericarp weakly adnate to the endosperm.

Distribution and habitat.—Native in the USA from Arizona to Oklahoma and Texas, southern Florida, common in México, sporadically in the Caribbean and in Mesoamerica through Bolivia, more common again from Bolivia and Chile through Paraguay, Uruguay, and southern Brazil and much of Argentina; in a variety of soil and vegetation types, but most frequently on well-drained slopes, 100–2600 m, but occasionally to 3150 m in Peruvian and Bolivian Andes.

Specimens examined. **COLOMBIA. Nariño:** Mun. Imúes, corregimiento El Pedregal, Pilcuán, 2000 m, 11 Jan 1989, *B. Ramírez 1259* (COL, PSO). Carretera Pasto-Túquerres, 1820–2600 m, 30 Nov 1962, *C. Saravia & R. Jaramillo 1869* (COL). Río Guaitara valley near junction of Panamericana and road to Túquerres, 1700 m, 1 Mar 1986, *J. Wood 5326* (COL, K, US).

2. Leptochloa fusca (L.) Kunth, Révis. Gramin. 1:91. 1829. *Festuca fusca* L., Syst. Nat., ed. 10, 2: 876. 1759, *nom. cons. prop. Diplachne fusca* (L.) P. Beauv. ex Stapf, Fl. Cap. 7:591. 1900, *nom. illeg. hom. Diplachne fusca* (L.) P. Beauv. ex Stuck., Anales Mus. Nac. Buenos Aires 11:128. 1904, *nom. illeg. hom. Diplachne fusca* (L.) P. Beauv. ex Roem. & Schult. *Uralepis fusca* (L.) Steud., Syn. Pl. Glumac. 1:247. 1855. Type: PALESTINE: *F. Hasselquist s.n.* (lectotype: LINN 92.21!, designated by Phillips, Fl. Trop. East Afr. Gram. 2:281. 1974).

Annuals, ascending to erect, sometimes geniculate and rooting at lower nodes. Culms to 130 cm tall (when erect); 1–8 mm wide, branched or unbranched; nodes glabrous; internodes (0.5–)3–26 cm long, hollow, herbaceous or sometimes firm. Leaf sheaths longer or shorter than the internodes, glabrous on sides and margins; collars mostly light brown or green; ligules 5–8 mm long, hyaline, apically attenuate but often becoming lacerated due to mechanical damage; blades (3–)5–50 cm long, 2–6 mm wide, linear, flat glabrous to somewhat scabrous above and below. Panicles 15–150 cm long, mostly 2–30 cm wide, partially included at base to completely exserted; the branches (1.5–)3–20 cm long, (3–)5–35 per panicle, alternate, sometimes reflexed or steeply erect but mostly somewhat ascending, stiff, minutely scabrous, the branch axils glabrous. Spikelets 5–12(–14) mm long, short pedicellate, more or less secund, sometimes distant near base of branches but overlapping near branch tips; florets (3–)6–12; callus glabrous or hairy; lower glumes 1.0–3.5(–4.9) mm long, membranous, lanceolate to ovate, usually scabrous on the midvein, broadly acute to acute, awnless or infrequently shortly awned; upper glumes 1.8–5.5 mm long, elliptic, usually ovate or widely ovate, sometimes obovate, scabrous on midvein, obtuse (rarely) or acute at apex, rarely short-awned; lemmas 2.3–6.0 mm long, membranous, elliptic, ovate, or lanceolate, the lateral veins distinct and often slightly excurrent, more or less sericeous on lateral veins and the midvein; apex truncate, obtuse, to acute or acuminate and sometimes bifid, awnless, mucronate, or awned, the awn to 3.5 mm long; paleas subequal or slightly exceeding lemma, more or less sericeous on veins; apex acute or obtuse; stamens 1, 2 or mostly 3; anthers 0.2–2.7 mm long. Caryopses 1.0–2.4 mm long, 0.7–1.2 mm wide, elliptic, ovate, or obovate in hilar profile, transversely elliptic to depressed obovate in transverse section, hilar groove lacking, smooth or sometimes slightly rugose, brown; pericarp weakly adnate to the endosperm.

Distribution.—Widespread and common to abundant in warm-temperate and tropical areas, between approximately 49°N and 40°S in the New World and 40°N and 42°S in Old World; mostly below 2000 m.

Comments.—Populations of the *Leptochloa fusca* complex often appear morphologically distinct in local areas, and dozens of names have been applied to regional forms throughout the Americas, Africa, and Australia. Since all morphological characters intergrade when considered globally most local variants do not merit taxonomic recognition (Snow 1997). However, herbarium work and multivariate statistical studies (Snow, unpubl.) based on eleven population samples (*n* = 30) from America, Africa, and Australia, support the recognition of four subspecies. The subspecies, which are usually easy to distinguish, are: *L. fusca* subsp. *fusca*, a polymorphic paleotropical taxon adventive in a few areas in the New World (Nicora 1995); *L. fusca* subsp. *muelleri* (Benth.) N. Snow, known from much of the interior of Australia (Sharp and Simon 2002); *L. fusca* subsp. *uninervia*, native to the neotropics but adventive elsewhere; and *L. fusca* subsp. *fascicularis*, native to the temperate and tropical regions of the New World.

KEY TO SUBSPECIES OF *LEPTOCHLOA FUSCA* IN COLOMBIA

1. Lowermost panicle branches often inserted in upper sheath; uppermost leaf blade length usually exceeding length of panicle; leaf sheaths sometimes mottled with anthocyanin pigments; lemmas often smokey white at maturity and with a dark spot in lower half ________ **2a. L. fusca** subsp. **fascicularis**

1. Lowermost panicle branches generally exserted from sheath; uppermost leaf blade length generally not exceeding terminal panicle; leaf sheaths only rarely mottled with anthocyanin pigments; lemmas smoky white or not, sometimes dark green or plumbeous, but usually not as a distinct spot ________ **2b. L. fusca** subsp. **uninervia**

2a. Leptochloa fusca subsp. **fascicularis** (Lam.) N. Snow, Novon 8:78. 1998b. (**Fig. 2, A–C**). *Festuca fascicularis* Lam., Tabl. Encycl. 1:189. 1791. *Diplachne fascicularis* (Lam.) P. Beauv., Ess. Agrostogr. 81, 160, pl. 16, f. 9. 1812. *Cynodon fascicularis* (Lam.) Raspail, Ann. Sci. Nat., Bot. 5:303. 1825. Type. South America. *D. Richard s.n.* (HOLOTYPE: P!; ISOTYPES: US-2875408!, US-2875408A fragm. ex P!).

Annuals, ascending to erect. Culms (3.5–)15–130 cm tall, 1–5(–8) mm wide, often branching, round; nodes glabrous; internodes 3–18 cm long, herbaceous, hollow. Leaf sheaths mostly longer than the internodes, glabrous on sides and margins; collar light green or brown; ligules 5–7 mm long, hyaline; blades 3–45 cm long, 2.5–7 mm wide, linear, usually sparsely scabrous above and below, flat but becoming involute when dry, midvein prominent. Panicles (1.5–)10–72 cm long, (1–)4–22 cm wide, generally partially included below; the branches 3–35, (0.5–)3–22 cm long, alternate, erect, ascending, or occasionally divergent, rigid or slightly flexuous, minutely scabrous, the axils glabrous. Spikelets 5–12 mm long, distant to mostly imbricate, pedicels less than 1 mm long; florets 6–12; callus glabrous; lower glumes 2–3 mm long, membranous, lanceolate or somewhat asymmetric, scabrous on midvein, acute to aristate and occasionally short-awned; upper glumes 2.5–5.0 mm long, membranous, elliptic to ovate, scabrous on midvein, obtuse, aristate, or short-awned; lemmas 2.5–5 mm long, membranous, lanceolate, light to dark green, light brown or smoky white, the lateral veins pronounced and extending to edges often as small teeth, sparsely sericeous along lateral veins and often midvein, glabrous between veins; apex acute to attenuate, often mucronate or with awns to 3.5 long; paleas generally subequal to lemma, elliptic, sericeous along veins; apex acute to obtuse; stamens 3; anthers 0.2–0.5 mm long, yellow. Caryopses 1–2 mm long, 0.8–1.0 mm wide, elliptic to obovate in hilar profile, transversely elliptic in transverse section, hilar groove lacking, smooth, brown; pericarp weakly adnate to the endosperm.

Distribution and habitat.—Massachusetts (USA) and southern Ontario (Canada) west to Washington (USA) and south to about latitude 40° S in Argentina; open mesic areas, brackish marshes along the eastern US seaboard, agricultural lands, ruderal sites along roads, and saline flats. Elevation from sea level to 1850 m.

Specimens examined. **COLOMBIA. La Guajira:** Costa del Caribe, llanura litoral arenosa y árida entre Mayapo y El Pájaro, 29 Jan 1964, *A. Dugand 6667* (COL, US).

2b. Leptochloa fusca subsp. **uninervia** (J. Presl) N. Snow, Novon 8:79. 1998b. (**Fig. 2, D–F**). *Megastachya uninervia* J. Presl, Reliq. Haenk. 1:283. 1830. *Poa uninervia* (J. Presl) Kunth, Enum. Pl. 1:344. 1833. *Eragrostis uninervia* (J. Presl) Steud., Syn. Pl. Glumac. 1:278. 1854. *Brizopyrum uninervium* (J. Presl) E. Fourn., Mex. Pl. 2:121. 1886. *Leptochloa uninervia* (J. Presl) Hitchc. & Chase, Contr. U.S. Natl. Herb. 18(7):383. 1917. *Diplachne uninervia* (J. Presl) Parodi, Revista Centro Estud. Agron. 18:147. 1925. Type: MÉXICO: *Haenke 101* (LECTOTYPE: PR!, designated by Snow, Novon 8:79. 1998b; DUPLICATES OF LECTOTYPE: LE-TRIN-2424.01!, US-78697 fragm.!, W!).

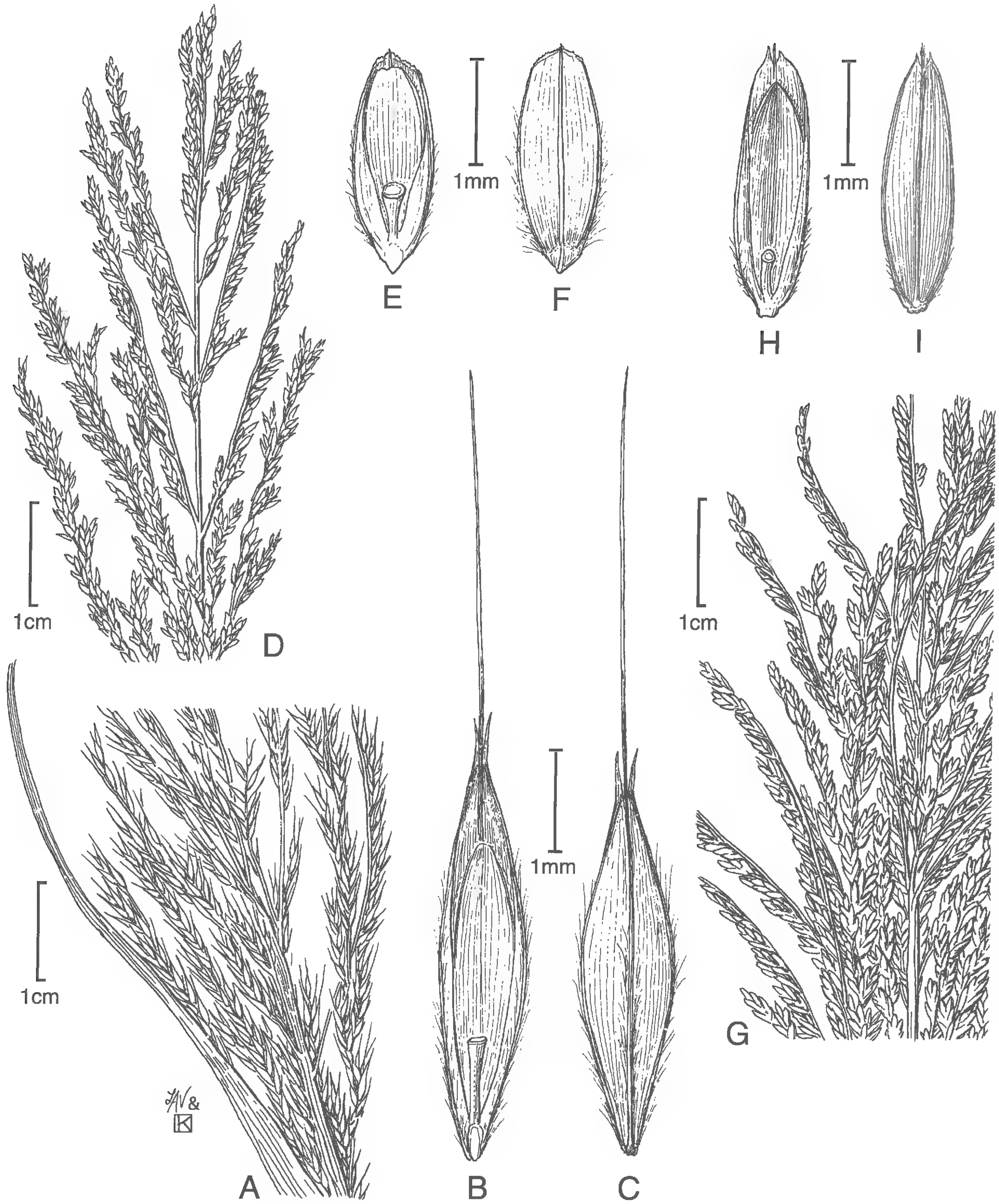

Fig. 2. ***Leptochloa fusca*** **subsp.** ***fascicularis.*** **A. Inflorescence. B. Floret with rachilla (ventral view). C. Lemma.** ***Leptochloa fusca*** **subsp.** ***uninervia.*** **D. Inflorescence. E. Floret with rachilla (ventral view). F. Lemma.** ***Leptochloa panicoides.*** **G. Inflorescence. H. Floret with rachilla (ventral view). I. Lemma.**

Annuals or occasionally weakly perennial in regions lacking frosts, erect or ascending. Culms (15–)25–110 cm tall, 2–5 mm wide, often branching, round; nodes glabrous; internodes 2–11 cm long, herbaceous, hollow. Leaf sheaths longer or shorter than the internodes, often flattened below, glabrous on sides and margins; collars mostly tan or green; ligules 5–8 mm long, hyaline; blades (2–)5–37 cm long, 2.0–5.5 mm wide, linear, usually densely scabrous above, sparsely to densely scabrous below, flat but becoming involute when dry, midvein prominent. Panicles 10–57 cm long, (0.5–)3–18 cm wide, usually exserted; the branches (3–)10–60, (0.3–)2–11 cm long, the branches mostly alternate, ascending to erect, stiff or slightly flexuous, minutely scabrous, the axils glabrous. Spikelets 5–10 mm long, rarely distant to normally imbricate (sometimes tightly so), pedicels mostly less than 1 mm long; florets (3–)6–10; callus sparsely sericeous; lower glumes 1.0–2.6 mm long, membranous, narrowly triangular, lanceolate, or ovate, glabrous or scabrous on midvein, acute to aristate or mucronate; upper glumes 1.8–2.8 mm long, membranous, obovate to widely ovate, glabrous or scabrous on midvein, obtuse, acute, or rarely mucronate; lemmas 2.0–3.6 mm long, membranous, ovate or elliptic, light brown to very dark green or somewhat plumbeous, lateral veins more or less prominent and generally extending to edges, sparsely sericeous below on lateral veins and often midvein, glabrous between veins; apex broadly acute, more commonly obtuse to truncate, sometimes bifid or mucronate; paleas subequal or slightly longer than lemma, membranous, elliptic, sericeous along veins; apex obtuse; stamens 3; anthers 0.4–1.0 mm long, yellow. Caryopses 1.0–1.5 mm long, 0.7–0.8 mm wide, elliptic, ovate, or obovate in hilar profile, transversely elliptic in transverse section, hilar groove lacking, smooth or slightly rugose, brown; pericarp weakly adnate to endosperm.

Distribution and habitat.—In the New World mostly south of latitude 37°N, south to Argentina, occasionally adventive in Old World (Snow and Simon 1999); open mesic areas, agricultural lands, saline flats, mangrove swamps. Elevation is from sea level to 1200 m.

Specimens examined. **COLOMBIA. Atlántico:** Entre Palmar de Varela y Ponedera, bosques xerofíticos, 10 m, 27 Ago 1960, *A. Dugand 5304* (COL, US). **Magdalena:** Ciénaga, alrededores de Aguacoca, 20 m, 21 Feb 1959, *R. Romero-Castañeda 7268* (COL, US).

3. Leptochloa panicea subsp. **brachiata** (Steud.) N. Snow, Novon 8:79. 1998b. (**Fig. 3, A–E**). *Leptochloa brachiata* Steud., Syn. Pl. Glumac., 209. 1854. Type: GUADALOUPE [French Republic]: *Duchassaing s.n.* (holotype: P!; US fragm.!).

Eleusine filiformis Pers., Syn Pl. 1: 87. 1805. *Leptochloa filiformis* (Pers.) P. Beauv., Ess. Agrostogr.: 71, 163, 166. 1812. Type: SOUTH AMERICA: *Richard s.n.* (holotype: P!).

Annuals, ascending to erect. Culms (10–)30–150 cm tall, mostly less than 5 mm wide, frequently branched; nodes glabrous; internodes mostly 5–30 cm long, hollow, herbaceous or sometimes firm. Leaf sheaths longer or shorter than the internodes, sparsely to moderately pilose (hairs with papillose bases); collars often magenta; ligules 1.0–3.2 mm long, membranous but erose apically; blades 6–25 cm long, 2–21 mm wide, linear, flat, glabrous to sparsely pilose on both surfaces. Panicles 8–30 cm long, usually 5–35 cm wide, occasionally partially included at base; the branches (1–)3–19 cm long, (3–)10–100 per panicle, alternate, ascending (mostly) to somewhat reflexed apically (but otherwise firm), minutely scabrous, the branch axils glabrous. Spikelets 2–4 mm long, short pedicellate, more or less secund, sometimes distant near base of branches but overlapping near branch tips; florets 2–5(–6); callus glabrous; lower glumes 1.6–4 mm long, membranous, lanceolate, usually scabrous on the midvein, acute, awnless; upper glumes 1.6–3.6 mm long, lanceolate, awnless; lemmas 1.3–1.7 mm long, membranous, lanceolate, more or less sericeous on lateral veins and the midvein; apex acute, awnless; paleas subequal to lemma; apex acute or obtuse; stamens 3; anthers 0.2–0.3 mm long. Caryopses 0.9–1.2 mm long, 0.5–0.6 mm wide, more or less rounded in hilar profile, widely depressed obovate to obdeltoid in transverse section, hilar groove narrow and shallow, smooth or sometimes slightly rugose, brown to reddish; pericarp adnate to the endosperm.

Distribution and habitat.—Southern third of United States through Mesoamerica and the West Indies to southern Brazil and Argentina; disturbed, mesic, and agricultural sites, to ca. 2800 m.

Comments.— *Leptochloa panicea* is a polymorphic species occurring throughout much of the warm temperate and tropical regions, and is comprised of three subspecies (Snow 1997, 1998a). Snow and Davidse (1993) reported that the name then in use for the widespread New World taxon, *L. filiformis* (Lam.) P. Beauv., was an illegitimate later homonym that should be replaced by *L. mucronata* (Michx.) Kunth. Although not the first to do so, Nowack (1994, 1995) recently placed New World specimens as a subspecies of the otherwise Old World species *L. panicea*, and made the new combination *L. panicea* subsp. *mucronata*. Included in Nowack's concept of *L. panicea* subsp. *mucronata* were two taxa formerly recognized as *L. filiformis* vars. *filiformis* and *attenuata*, which Snow (1997, 1998b) treated (respectively) as *L. panicea* subsp. *brachiata* (Steud.)

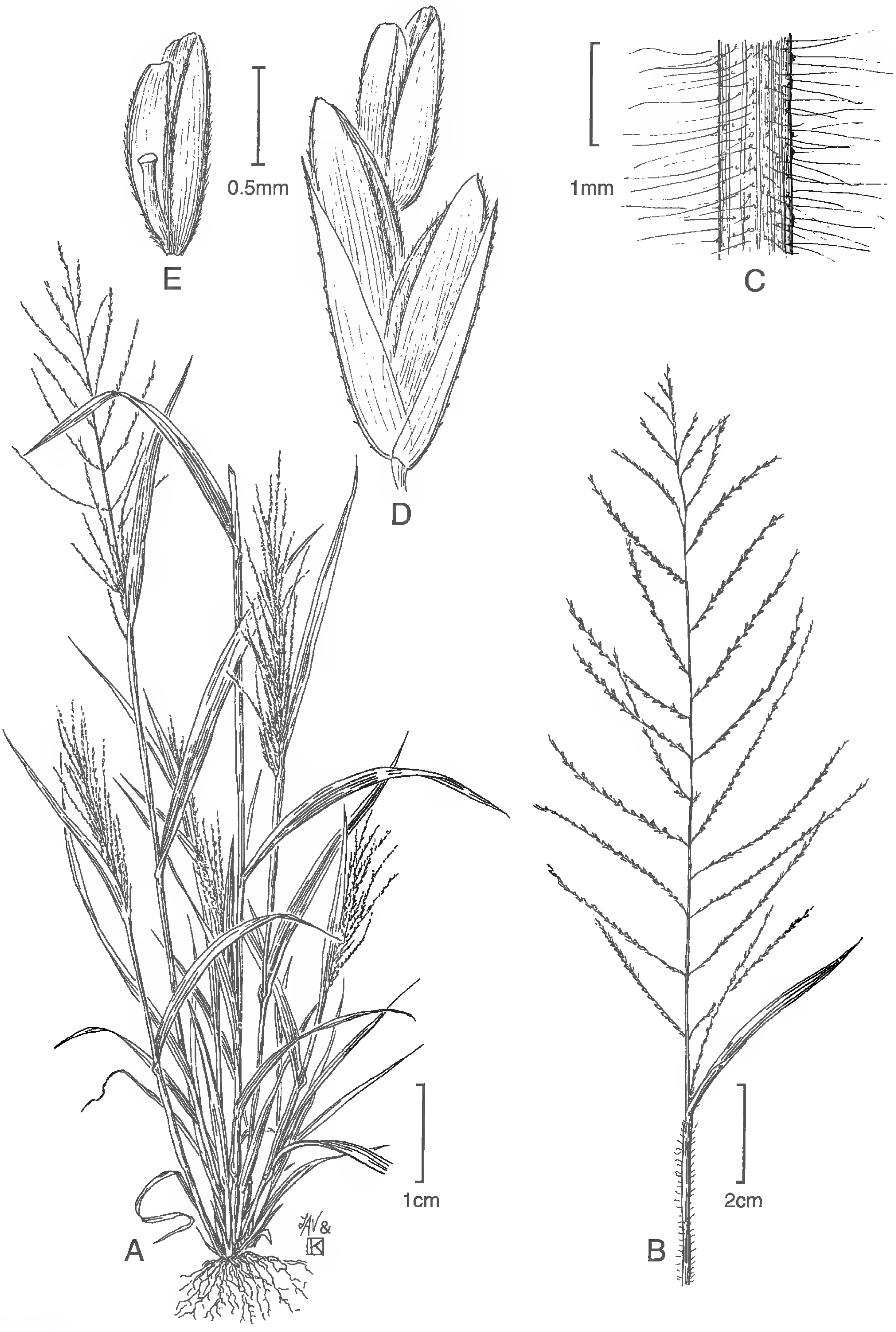

Fig. 3. *Leptochloa panicea* subsp. *brachiata*. **A.** Habit. **B.** Inflorescence. **C.** Portion of the leaf sheath with a covering of papillose-based hairs. **D.** Spikelet. **E.** Floret with rachilla (lateral view).

N. Snow and *L. panicea* subsp. *mucronata* (Michx.) N. Snow. The much more widespread taxon, referred to earlier as *L. filiformis* or *L. mucronata* (Snow & Davidse, 1993), was given the new name *L. panicea* subsp. *brachiata* (Snow 1998b).

Drawing on field experience and examination of over 4,000 herbarium specimens, Snow (1997) concluded that the phenetic variation is sufficiently consistent to warrant recognition of three subspecies. Only *L. panicea* subsp. *brachiata* is present in Colombia.

Vernacular name.—Pasto paja-mona (Valle del Cauca).

Specimens examined. **COLOMBIA. Antioquia:** Mun. Necoclí, 42 km carretera Necoclí-Arboletes, en barranco muy seco, 160 m, 29 Sep 1986, *J. Betancur et al. 298* (COL, HUA, MO). Mun. Arboletes, en playa, 30 Sep 1986, *J. Betancur et al. 316* (COL, HUA, MO). La Pintada, grassland at Hacienda Montenegro near La Pintada, 600 m, 20 Oct 1947, *C. Blackman, J. Mejía & F. Barkley 17-C284* (COL). Mun. Bolívar, carretera Bolívar-Caramanta, km 5 arriba de Ricaurte, margen izquierda del Río Cauca, *Cabrera 647* (MO). Vicinity of Medellín, 30 Jul 1927, *R. Toro 327* (US). **Atlántico:** Entre Palmar de Varela y Ponedera, hacienda El Paraíso, orillas del Río Magdalena, 10 m, 28 Jan/8 Feb 1950, *A. Dugand 4435* (COL). Barranquilla, El Prado, 60 m, 30 Dec 1958, *A. Dugand 5074* (COL). Cerca de Barranquilla, carretera a Juanmina, 20 m, 10 Jul 1960, *A. Dugand 5267* (COL, US). Puerto Colombia, Sabanilla, 21 Nov 1912, *A. Hitchcock 9932* (US). Al sur de Barranquilla, cerca de Martillo, 5–10 m, 29 Abr 1960, *L. Mora 1344* (COL). Barranquilla, year 1926, *B. Paul C-17* (US). **Bolívar:** Mun. Turbaco, jardín botánico "Guillermo Piñeres," 6 Ago 1980, *J. Espina 499* (COL). Cartagena, 20 Nov 1912, *A. Hitchcock 9919* (US). Mun. San Martín de Loba, corregimiento La Ribona, reserva natural El Garcero, finca La Buenaventura, *Ramírez & Villa 4664* (MO). **Cauca:** Between Río Mayo and Galindez, 800 m, 26 Oct 1983, *J. Wood 4060* (COL, US). **Cundinamarca:** 14 km WNW of Melgar, 330 m, 8 Jan 1974, *G. Davidse, A. Gentry & F. Llanos 5573* (COL, MO). Poblado de Nariño, zonas ruderales, 340 m, 15 Feb 1986, *J. Fernández & R. Jaramillo 5230* (COL). Montañuela, San Bernardo, 1400 m, 19 Mar 1961, *J. Idrobo & Dumont 4438* (COL). Mun. Tocaima, ca. 500 m, Dec 1934, *E. Pérez-Arbeláez 2419* (COL), *2424* (COL). Mun. Útica, en granja experimental, 467 m, 13 Oct 1962, *C. Saravia 1373* (COL). 5 km of El Nilo, 16 Jun 1985, *J. Wood 4927* (US). **Huila:** Mun. El Agrado, quebrada La Yaguilga, campos de cacao y zonas de matorral circundantes, ca. 700 m, Sep 1986, *J. Fernández & G. Morales 6839* (COL). **Magdalena:** Santa Marta, 1898–1899, *H. Smith 213* (US), *2163* (US). **Santander:** Bajo Magdalena, Isla de Venado, inter Billete Blanco et El Presidio, 7 May 1926, *S. Juzepczuk 4770* (US). San Gil, 1250 m, year 1983, *J. Wood 3885* (COL). Bajo Magdalena, Barrancabermeja, 6 Abr 1926, *G. Woronow & S. Juzepczuk 4428* (US). **Tolima:** Mun. Espinal, 500 m, Sep 1859, *M. Lindig 1033-P33*. **Valle del Cauca:** Río Cauca, alrededores de Palmira, 1000 m, 3 Dec 1947, *R. Cardeñosa et al. 17-C937* (COL, US), *R. Murgueitio et al. 17-C929* (US). Hacienda El Trejo, entre El Cerrito y Palmira, 1050 m, 28 Dec 1938/5 Jan 1939, *H. García-Barriga 6339* (COL, US). Mun. Palmira, Ingenio La Manuelita, 1000 m, 29 Jul 1966, *J. Páez 23* (COL). Mun. Palmira, granja agrícola experimental, 5 Jan 1957, *A. Ramírez 14* (COL). Loboguerrero, 1050 m, 12–14 Nov 1962, *C. Saravia 1483* (COL). Mun. Palmira, 1100 m, no date, *A. Villamizar s.n.* (COL: 82436). **Unknown department:** Río Frío, 23 Jun 1906, *H. Pittier 1584* (US).

4. Leptochloa panicoides (J. Presl) Hitchc., Amer. J. Bot. 21:137: 1934. (**Fig. 2, G–I**). *Megastachya panicoides* J. Presl, Reliq. Haenk. 1(4–5):283. 1830. *Poa panicoides* (J. Presl) Kunth, Enum. Pl. 1:343. 1833. *Eragrostis panicoides* (J. Presl) Steud., Syn. Pl. Glumac. 1:278. 1854. *Diplachne panicoides* (J. Presl) McNeill, Brittonia 31:402. 1979. TYPE: MÉXICO: Habitat in México ad Acapulco, verosimiliter inlutosis, *Haenke s.n.* (HOLOTYPE: PR; ISOTYPES: IT: LE-TRIN-2121.02!, MO-2109566!, MO-2109567 line drawing!, US-78688 fragm.!).

Annuals, often geniculate below but generally erect. Culms (7–)45–110 cm tall, 1–7 mm wide, branching (sometimes profusely), round; nodes glabrous; internodes (1–)4–10 cm long, herbaceous, hollow. Leaf sheaths generally longer than the corresponding internodes, somewhat flatted below, glabrous, the margins sometimes very sparsely ciliate along the lower half; collars sometimes magenta; ligules 2.2–3.8 mm long, membranous, truncate, somewhat erose apically; blades 4–20 cm long, mostly 4–8 mm wide, linear or the shorter ones lanceolate, glabrous to minutely scabrous above and below. Panicles (1–)20–35 cm long, (3–)4–12 cm wide, generally exserted; the branches (20–)40–90, 2.5–7 cm long, alternate, mostly ascending, stiff to weakly flexuous, minutely scabrous, the axils glabrous. Spikelets 4–5 mm long, generally somewhat imbricate, pedicles 1–2 mm long; florets (4–)5 or 6(–7); callus glabrous; lower glumes 0.9–1.9 mm long, membranous, narrowly lanceolate to lanceolate or sometimes falcate, minutely scabrous on the midvein, acute; upper glumes 1.8–2.3 mm long, membranous, ovate, minutely scabrous on the midvein, acute to obtuse; lemmas 2.4–3.0 mm long, membranous, narrowly elliptic to ovate, tan, maroon, or green, lateral veins pronounced, projecting abaxially, and usually bright green, sericeous (sometimes scarcely so) at base of lateral veins and/or midvein; apex acute to broadly acute, awnless or mucronate; paleas subequal to ca. 2/3 as long as the lemma, membranous, ovate to elliptic, glabrous throughout; apex obtuse; stamens 3; anthers 0.6–0.8 mm long, maroon or yellow. Caryopses 1.1–1.4 mm long, 0.7 mm wide, elliptic in hilar profile, depressed obovate in transverse section, hilar groove lacking, smooth or somewhat rugose, brown; pericarp tightly adnate to the endosperm.

Distribution and habitat.—From central Mississippi and Ohio River drainages in the United States south through Mesoamerica to Brazil; generally in mesic sites. Elevation: sea level to 500 meters.

Specimens examined. **COLOMBIA. Amazonas:** Beira Río Loretoyacu, perto da fazenda Wandurraga, 28 Sep 1946, *G. Black & R. Schultes 46-158* (COL); Río Loretoyacu, Oct 1946, *G. Black & R. Schultes 46-169* (COL, GH, US), *46-184* (COL, US); Trapecio Amazónico, Loretoyacu River, ca. 100 m, Oct 1946, *R. Schultes & G. Black 8503* (COL, GH, US). **Casanare:** Mun. El Yopal, sabanas alteradas no inundables, finca La Armonía, en inmediaciones de un cultivo de arroz, ca. 400 m, 3 Nov 2007, *D. Giraldo-Cañas et al. 4156* (CAUP, COAH, COL).

5. Leptochloa scabra Nees, Agrostogr. Bras. 2: 435. 1829. (**Fig. 1, D–F**). *Diplachne scabra* (Nees) Nicora, Hickenia 2(19):91. 1993. Type: BRAZIL: Pará, in ripa fluminum Amazonum, Tagipuris, *K.F.P. von Martius s.n.* (holotype: M!; isotypes: BAA-1514 fragm ex M, US-88699 fragm.ex M!).

Vigorous annuals mostly erect, rarely geniculate at the base. Culms (12–)20–125 cm tall, (0.6–)1–6.2 mm wide, branching, keeled and compressed; nodes glabrous; internodes 6–9 cm long, herbaceous or hard, hollow. Leaf sheaths usually shorter than or equal to internodes, often flattened below, glabrous to scabrous, the margins glabrous; collars magenta to dark maroon; ligules (0.5–)1.5–2.5 mm long, thinly membranous with numerous hairs arising from base of the blade, truncate, fimbriate to erose apically; blades (4–)25–35(–50) cm long, (3–)8–16 mm wide, linear to lanceolate, scabrous above and below, flat, midvein prominent. Panicles (10–)15–35 cm long, (2–)7–12 cm wide, usually partially included; the branches 50–150, (2–)5–12 cm long, alternate, ascending to erect, flexuous to prominently arcuate, minutely scabrous, the axils glabrous. Spikelets 3.0–4.5 mm long, mostly imbricate, short-pedicellate; florets 4–6; callus glabrous; lower glumes 0.8–1.6 mm long, membranous, narrowly triangular, triangular, or trullate, minutely scabrous on the midvein, acute to mucronate; upper glumes 1.1–2.1 mm long, membranous, ovate, glabrous or scabrous, obtuse, acute, or mucronate; lemmas 2.1–2.4 mm long, membranous, lanceolate to narrowly ovate, light green becoming tan, the lateral veins extending to near edge of lemma but less distinct apically, sparsely sericeous along lower 1/2 of veins; apex acute, awnless or mucronate; paleas subequal to lemma, membranous, lanceolate, sparsely sericeous along lower part of lateral veins, bifid apically; stamens 3; anthers 0.2–0.4 mm long, yellow or light brown. Caryopses 0.8–1.3 mm long, 0.3–0.5 mm wide, elliptic to obovate in hilar profile, depressed obovate in transverse section, hilar groove lacking, smooth to slightly rugulose; pericarp weakly adnate to endosperm.

Distribution and habitat.—Native distribution from the United States of America (Alabama and Louisiana) to the West Indies, Mesoamerica to Paraguay and Brazil. Its introduced range includes Africa (Angola and Mali) and Papua New Guinea; creek banks, disturbed alluvial areas, river margins, agricultural fields. Elevation 0–750 m.

Comments.—*Leptochloa scabra* can be confused with *L. panicoides*. The former is distinguished by its shorter and more tightly imbricate spikelets, the keeled lemmas, its distinctly flexuous to arcuate panicle branches, and culms that are somewhat flattened near the base.

Specimens examined. **COLOMBIA. Amazonas:** Leticia, 17 Ago 1946, *G. Black & R. Schultes 46-2* (US). Río Loretoyacu, Oct 1946, *G. Black & R. Schultes 46-185* (COL, GH, US). Río Caquetá, *J. Duivenvoorden et al. 71* (MO). **Antioquia:** Mun. Chigorodó, hacienda Montecristo, 25 km después de Apartadó, cultivo de chontaduro (*Bactris gasipaes*), 40 m, 2 Oct 1986, *J. Betancur et al. 345* (COL, HUA, MO). **Atlántico:** al sur de Barranquilla, Río Magdalena, en la isla frente a Puerto Giraldo, 5–10 m, 29 Abr 1960, *L. Mora 1455* (COL). **Bolívar:** Río Sinú, 10–100 m, 11 Feb 1918, *F. Pennell 4195* (US). Boca Esmeralda, on Río Sinú, 200–400 m, 1 Mar 1918, *F. Pennell 4554* (GH, NY, US). **Cauca:** Mun. Patía, a 2 km de Mojarras, granja Universidad de Nariño, 700 m, 23 Abr 1988, *B. Ramírez 1127* (COL, PSO). **Chocó:** alrededores de la confluencia de los Ríos Chintadó y Truandó, 25 Mar 1958, *P. Bernal 52* (COL, MO). Río Truandó, gallery between the boom and Río Salado, *Duke 11100* (NY). Río Juradó, *Sneider A-202* (A, MICH). **Guainía:** Bacco de Minas, 400 m, Dec 1976, *C. Domínguez 18* (COL), *21* (COL). **Guaviare:** Mun. San José del Guaviare, desde el puerto hasta la desembocadura del caño La Fuga, margen izquierda del río Guaviare, aguas arriba en bordes de Río, en suelos de areniscas, 200 m, 17 Feb 1996, *R. López 997* (COAH, COL). Angostura Nro. 2, margen derecha del Río Guayabero, 23 Feb 1969, *P. Pinto & C. Sastre 1012* (COL). **Huila:** 3 km W of Palermo towards Santa María, 500 m, 16 Mar 1985, *J. Wood 4749* (COL). **Magdalena:** isla de Salamanca, entre caño Calrín y la carretera, del km 10 al 15, 20 Jun 1970, *N. de López 472* (COL). Región de Santa Marta, en Ciénaga, El Arsenal, alrededores de la ciudad, 17 Feb 1950, *R. Romero-Castañeda 1979* (COL). **Meta:** Reserva Nacional La Macarena, margen izquierda del Río Guayabero, al pie de las mesetas del sur, frente a la confluencia del caño Losada, 300 m, 3 Mar 1959, *R. Jaramillo & J. Hernández 2079* (COL). Margen derecha del Río Guayabero, raudal de La Macarena (Angostura Nro. 1), 350 m, 24 Jan 1959, *P. Pinto & Bischler 343* (COL, US). Margen izquierda del Río Guayabero, 10 km abajo del caño Losada, 350 m, 30 Jan 1959, *P. Pinto & Bischler 368* (COL, US). **Sucre:** Mun. Tolú, ciénaga La Caimanera, 17 km Tolú-Coveñas, golfo de Morrosquillo, transición entre manglar y una ciénaga cultivada con arroz, que conduce a la tierra firme, 0–5 m, 20 Sep 1990, *J. Betancur & M. Berrío 1994* (COL, HUA, MO, US). **Valle del Cauca:** Mun. Yotoco, Ingenio La Carmelita, sección San Martín, *Ramos et al. 2828* (MO). Mun. Yumbo, Finca Río Grande, pasture around the houses, 1200 m, 13 Jun 1998, *D. Stancik 793* (COL). **Unknown department:** *J.C. Mutis 5428* (US).

6. Leptochloa virgata (L.) P. Beauv., Ess. Agrostogr. 71, 161, 166, pl. 15, f. 1. 1812. (**Fig. 1, G & H**). *Cynosurus virgatus* L. Syst. Nat. (ed. 10):876. 1759. *Festuca virgata* (L.) Lam., Tabl. Encycl. 1:189. 1791. *Eleusine virgata* Pers., Syn. Pl. 1:87. 1805. *Leptostachys virgata* (L.) G. Mey., Prim. Fl. Esseq., 74. 1818. *Cynodon virgatus* (L.) Raspail, Ann. Sci. Nat., Bot. 5:302. 1825. TYPE: JAMAICA: *P. Browne s.n.* (LECTOTYPE: LINN-91.18! designated by Hitchcock, Contr. U.S. Natl. Herb. 12:122. 1908).

Perennials, ascending to erect or infrequently geniculate and rooting at nodes. Culms 30–100 cm tall, (1–)3–5 mm wide, branched, round or occasionally flat; nodes glabrous; internodes 4–35 cm long, herbaceous or firm, solid. Leaf sheaths longer or shorter than internodes, round, glabrous, or shortly sericeous to sometimes pilose, particularly near the collar, the margins similar; collar green or tan; ligules 0.2–1.0 mm long, firmly membranous or cartilaginous, truncate, somewhat fimbriate or erose apically; blades (2.5–)10–44 cm long, 4–16 mm wide, lanceolate, glabrous, scabrous, or sparsely pilose from small papilla above and below, flat, midvein prominent or reduced. Panicles (5–)12–60 cm long, (2–)3–20 cm wide, exserted; the branches 9–60, (1.5–)3–18 cm long, alternate or rarely subdigitate, ascending to nearly erect, flexuous, scabrous, the axils usually pilose. Spikelets (1.7–)3–4 mm long, mostly imbricate or somewhat distant at base of panicle branches, sessile or nearly so; florets (2–)4 or 5(–6); callus glabrous, scabrous, to velutinous or pilose; lower glumes (1.0–)1.7–2.9 mm long, membranous, lanceolate, minutely scabrous on midvein, acute, attenuate, or rarely obtuse; upper glumes (1.4–)1.7–2.5(–3.8) mm long, membranous, ovate to lanceolate, minutely scabrous on midvein, obtuse, acute, acuminate, or rarely mucronate; lemmas (1.5–)2.3–3.6 mm long, chartaceous, ovate, light brown to maroon but apparently never deep green, lateral veins faint and not extending to the edges, nearly glabrous to sericeous on veins, glabrous or sparsely sericeous on sides; apex acute or rarely obtuse, awnless or awned (awns up to 11 mm long in other parts of South America); paleas subequal to lemma, firmly membranous or chartaceous, lanceolate to narrowly elliptic, glabrous or sparsely sericeous between veins; apex acute; stamens 2; anthers ca. 0.5 mm long, light purple. Caryopses (1.0–)1.3–1.8 mm long, ca. 0.5 mm wide, narrowly elliptic to ovate in hilar profile, rounded shallowly obdeltate to widely obovate in transverse section, hilar groove lacking or fairly pronounced but shallow or relatively broad and shallow, smooth, mostly light reddish brown; pericarp tightly adnate to the endosperm.

Distribution and habitat.—From southern Texas, southern Florida, and the West Indies through Mesoamerica and South America (excluding Chile) and locally in Papua New Guinea and Papua Province, Indonesia (formerly Iryan Jaya); occurring in numerous vegetation and soil types, but mostly in more mesic climates. Elevation: sea level to 1300 m.

Vernacular names.—Painoo (Casanare), Rabo de zorro (Tolima).

Specimens examined. **COLOMBIA. Antioquia:** Vuelta de Acuña, Río Magdalena, 125–130 m, 14 Jan 1918, *F. Pennell 3803* (NY, US). Mun. Santa Fe de Antioquia, finca Cotové, 580 m, 24 Sep 1986, *R. Pohl 15594* (HUA, MO, US). Vicinity of Medellín, 30 Jul 1927, *R. Toro 332* (US). Mun. Santa Fe de Antioquia, along road Santa Fe de Antioquia-Anzá, ca. 1 km W of crossing of Río Tonuzco at its confluence with Río Cauca, near Finca Cotové, 615 m, 19 Sep 1987, *J. Zarucchi et al. 5486* (COL, MO, NY). **Atlántico:** Entre Juanmina y Cuatrobocas, finca Bajoebula, bosques áridos, 80–100 m, 15–16 Jan 1946, *A. Dugand & R. Jaramillo 4037* (COL, US). Entre Palmar de Varela y Ponedera, hacienda El Paraíso, orillas del Río Magdalena, 10 m, 8–10 Jan 1954, *A. Dugand 4704* (COL, US). **Bolívar:** Along the Caño Chacagua, N to Los Piñones, Island of Mompós, Lands of Loba, Abr–May 1916, *H. Curran 260* (US). Cartagena, 20 Nov 1912, *A. Hitchcock 9923* (US). Río Magdalena, boca de bosque, 50 m, 18 Dec 1969, *J. Idrobo 6309* (COL). Soplaviento and vicinity, 5–10 m, 16 Nov 1926, *E. Killip & A. Smith 14606* (GH, MO, NY, US). Cañabetal, Río Magdalena, 90–100 m, 15 Jan 1918, *F. Pennell 3883* (GH, MO, NY, US). **Casanare:** Mochuelo y Tsamaní, margen derecha del bajo Casanare, 3 Jul–6 Ago 1984, *F. Ortiz 525* (COL). **Chocó:** Río Truandó, gallery between the boom and Río Salado, *Duke 11079* (NY). **Cundinamarca:** poblado de Nariño, zonas ruderales, 340 m, 15 Feb 1986, *J. Fernández & R. Jaramillo 5206* (COL). Mun. Caparrapí, hacienda Saldaña, 1280 m, 10–13 Jun 1939, *H. García-Barriga 7742* (COL). La Mesa, camino de herradura de La Mesa a San Javier, 950–1320 m, 2–20 Jan 1947, *H. García-Barriga 12135* (COL). Montañuela, San Bernardo, 1400 m, 19 Mar 1961, *J. Idrobo & Dumont 4440* (COL). Cune, 1200 m, Jul 1860, *M. Lindig 1121-P122* (COL). Nariño, ca. 500 m, Jul 1930, *E. Pérez-Arbeláez 460*

(COL). Nilo, Jul 1930, *E. Pérez-Arbeláez 504* (COL). Near La Mesa on the road El Colegio, 1000 m, year 1983, *R. Wood 3588* (COL). **Huila:** Mun. Villavieja, Fortalecillas, km 2 vía a Villavieja, 450 m, *B. Ramírez 13169* (CAUP, COL). Río Saldaña to Natagaima, *Rusby & F. Pennell 240* (NY). **Magdalena:** Santa Marta, 1898–1899, *H. Smith 188* (GH, US). Santa Marta, 1898–1899, *H. Smith 2160* (US). **Meta:** Los Llanos, Río Meta, El Porvenir, 16 Oct 1938, *J. Cuatrecasas 3692* (COL, NY, US). Los Llanos, río Meta, isla de arenal en Vuelta Mala, 17 Oct 1938, *J. Cuatrecasas 3790* (US). Margen izquierda del Río Guayabero, 10 km abajo del caño Lozada, 350 m, 30 Jan 1959, *P. Pinto & Bischler 366* (COL). **Nariño:** Carretera Panamericana, debajo del puente de Mojarras, 800 m, en bosque seco tropical, 15 Jan 1989, *J. Ortiz 1316* (COL). **San Andrés, Providencia y Santa Catalina:** Isla de San Andrés, ca. 5 m, no date, *R. Toro 38* (COL). **Santander:** Bajo Magdalena, Isla de Venado, inter Billete Blanco et El Presidio, 7 May 1926, *S. Juzepczuk 4744* (US), *4750* (US). 6 km al sur de Palyón, 800 m, 2 Ago 1966, *A. Robinson & C. Beltrán 3023-A* (US). San Gil, 1250 m, year 1983, *R. Wood 3868* (COL). Chicamocha Valley, Pescadero Piedecuesta, in stable sand along the margins of the Río Manco, 700 m, 3 Jul 1984, *J. Wood 4490* (COL). **Tolima:** Mun. Espinal, en Calicheros frente al molino San Martín, no date, *R. Echeverry 1080* (COL). Mun. Espinal, 500 m, Dec 1859, *M. Lindig 1107-P106* (COL). Between Guamo and Saldaña, 300 m, 11 Nov 1983, *R. Wood 4096* (COL). **Valle del Cauca:** Plana del Valle, entre Gorgona y Cabuyal, 1000 m, 2 Jun 1943, *J. Cuatrecasas 14495* (US). Plana del Valle, extremo norte, Cartago, en San Jerónimo, 980 m, 15 Nov 1946, *J. Cuatrecasas 22841* (US). La Manuelita, near Palmira, eastern side of Cauca Valley, 1100–1302 m, Dec 1905–Jan 1906, *H. Pittier 832* (US). Hacienda Vidal, ca. 3 km delante de Vijes, vía Vijes-Yotoco, *Ramos & Ramos 2278* (MO). Corregimiento de Mulaló, en la vía Yumbo-Vijes, *Ramos & Ramos 3151* (MO). Entre Loboguerrero y Yumbo, 1000–1100 m, 14–18 Nov 1962, *C. Saravia 1620* (COL). Mun. Cali, Universidad del Valle, *Silverstone-Sopkin 1996* (MO). **Unknown departamento:** *J.C. Mutis 5427* (US), *5429* (US).

EXCLUDED NAME

Tridens virens Nees, Fl. Bras. Enum. Pl. 2:476. 1829. *Uralepis virens* (Nees) Kunth, Enum. Pl. 1:319. 1833. *Diplachne virens* (Nees) Parodi, Rev. Fac. Agron. Vetrin. 6:14. 1927. Type: BRAZIL: "Habitat in graminosis ad fluvim S. Francisci in provincia Bahiensi et Permambucana, ad Joazeiro et alibi." We do not know where the type is housed and have not seen it. Chase and Niles (1962) indicate that the "type is *Leptochloa fascicularis* [=*L. fusca* subsp. *fascicularis*] or affine."

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ERAGROSTIS (POACEAE: CHLORIDOIDEAE: ERAGROSTIDEAE) IN COLOMBIA

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ABSTRACT

A taxonomic summary is presented for the Colombian species of *Eragrostis*. The genus *Eragrostis* is represented in Colombia by 25 species and one nontypical subspecies. *Eragrostis mokensis* Pilg., *E. nigricans* (Kunth) Steud., and *E. rufescens* Schrad. ex Schult. are reported for the first time in Colombia. Keys for determining the species, descriptions, illustrations, geographical distributions, and morphological and ecological observations are provided for all native and adventive species of *Eragrostis* in Colombia. *Eragrostis patula* (Kunth) Steud. (= *Poa patula* Kunth) and *E. unioloides* (Retz.) Nees ex Steud. (= *Poa unioloides* Retz.) are excluded from the Colombian Flora since all specimens identified as *E. patula* are apparently misidentified and are usually referable to *Eragrostis tenuifolia* (A. Rich.) Hochst. ex Steud. A single specimen identified as *Eragrostis unioloides* as cited in the Antioquia's Flora was misidentified and is referable to *Poidium juergensii* (Hack.) Matthei.

RESUMEN

Se presenta un estudio taxonómico de las especies colombianas del género *Eragrostis*. Este género está representado en Colombia por 25 especies y una subespecie, de las cuales *Eragrostis mokensis* Pilg., *E. nigricans* (Kunth) Steud. y *E. rufescens* Schrad. ex Schult. se citan por primera vez para la flora de Colombia. Se presentan las claves para reconocer las especies nativas y adventicias presentes en Colombia, así como las descripciones de éstas, la iconografía, la distribución geográfica y se comentan algunas observaciones morfológicas y ecológicas. Las especies *E. patula* (Kunth) Steud. (= *Poa patula* Kunth) y *E. unioloides* (Retz.) Nees ex Steud. (= *Poa unioloides* Retz.) se excluyen de la flora colombiana. *Eragrostis patula* es frecuentemente considerada en floras locales de Colombia; sin embargo, los especímenes referidos a dicha especie pertenecen a *E. tenuifolia* (A. Rich.) Hochst. ex Steud. Por otra parte, *E. unioloides* ha sido citada, en base a un único ejemplar, para la Flora de Antioquia, pero realmente el espécimen corresponde claramente a *Poidium juergensii* (Hack.) Matthei.

Eragrostis is a large genus of approximately 350 species occurring in tropical, subtropical and warm temperate regions throughout the world (Clayton & Renvoize 1986; Watson & Dallwitz 2008; Peterson et al. 1995, 1997; Lazarides 1997; Veldkamp 2002; Ingram & Doyle 2007; Peterson & Sánchez Vega 2007). There are 111 species of *Eragrostis* recorded in North, Central, and South America, and 67 native in South America (Peterson & Boechat 2001; Peterson 2003; Peterson et al. 2001, 2007). The genus is characterized by having many-flowered spikelets where the disarticulation of the lemma and palea occurs separately, lemmas that are usually 3-nerved and unawned, longitudinally bowed-out paleas with ciliolate keels, paniculate inflorescences, and leaves with ciliate ligules (Peterson et al. 1997). Most species of *Eragrostis* occupy open habitats with poor soils, and many occur in ruderal sites (Clayton & Renvoize 1986; Van den Borre & Watson 1994), and their distribution exhibits wide altitudinal gradients and a high variation in humidity conditions, from the sea level to 3600(–4000) m, and from pluvial environments to xeric habitats, respectively.

Colombia is placed in the Neotropical Region and encompasses 1,141,748 km^2. The geomorphological and environmental complexity of Colombia is tremendous where there is an altitudinal gradient from sea level to over 5800 m, and climates can vary from wet and humid to xeric and dry. The country can be divided into three major regions: the Andes with three Cordilleras (Occidental, Central, and Oriental), the Pacific Region, and the Caribbean territories. In Colombia there are a multitude of habitats for plants to occupy and this has lead to its high biodiversity, second only to Brazil. The Poaceae are a diverse family that occupies a myriad of terrestrial habitats in Colombia. According to our inventories, the Poaceae is represented in Colombia by 811 species [a single genus (*Agrostopoa* Davidse, Soreng, and P.M. Peterson; Davidse et al. 2008) and 40 species are endemic to Colombia] that are currently placed in 157 genera. The grass family is the third largest family of vascular plants in Colombia behind the Orchidaceae and Asteraceae.

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In Colombia the Panicoideae (350 species/63 genera), Pooideae (148 species/36 genera), and Chloridoideae (98 species/25 genera) are the richest grass subfamilies. The largest genera are *Paspalum* (83 species), *Panicum* (48), *Festuca* (33), *Chusquea* (25), *Eragrostis* (25), *Calamagrostis* (23), *Axonopus* (22), *Digitaria* (19), *Setaria* (15), *Aulonemia* (12, Judziewicz, per. comm.), *Lasiacis* (12), *Agrostis* (11), *Muhlenbergia* (10), and *Sporobolus* (10). The species within these subfamilies exhibit a specific distribution that is correlated with the altitude and/or with the rainfall patterns. Therefore, the Panicoideae are more diverse in the lowlands and wet areas where precipitation is high, the Pooideae are best represented in the high elevation páramos, and the Chloridoideae are best represented in dry areas at mid-levels of elevation.

Two centers of species diversity have been recognized in Colombia: the Llanos Orientales (Orinoco Region) and the páramos (Giraldo-Cañas 2007). The Orinoco Region is dominated with C_4 grasses and neotropical elements, whereas the páramos are dominated with C_3 grasses and holartic and/or cosmopolitan genera. Despite different analyses, the results indicate there is no clear pattern in regards to endemism in these natural areas (Giraldo-Cañas 2007).

As a result of our studies, 11 new species and one new genus have been described, and 18 genera and 82 species have been recorded for the first time in Colombia (Giraldo-Cañas 2007). This serves to emphasize the tremendous variety and botanical interest present in Colombia, a floristically diverse neotropical country. The taxonomic knowledge of this family in Colombia is incomplete, and it is still possible to encounter novel species and many new records for this country. There have been very few taxonomic studies investigating Colombian grasses integrating the newest classifications based on molecular evidence. The data also indicate a need to increase field exploration, primarily in the Llanos Orientales, Sierra Nevada de Santa Marta, Nariño, and the Caribbean Region.

We report 25 species and one nontypical subspecies of *Eragrostis* for the Colombian Flora, three of the species are cited for the first time for Colombia: *Eragrostis mokensis* Pilg., *E. nigricans* (Kunth) Steud., and *E. rufescens* Schrad. ex Schult. Our taxonomic treatment contains a key for determining species, descriptions, distributions, specimens examined, illustrations, and synonymies. Only synonyms used frequently in Colombian literature and those of South American origin are given. For further synonymy see Peterson et al. (2001), Peterson & Boechat (2001), and Soreng et al. 2008. This study is based on the examination of herbarium specimens from COAH, CAUP, COL, HUA, MO, PSO, and US, including the type specimens of most species studied. The present study contributes knowledge of the Colombian grasses in collaboration with the Biodiversity Program and Colombian Flora Inventories.

TAXONOMIC TREATMENT

Eragrostis Wolf, Gen. Pl. 23. 1776. Type: *Eragrostis minor* Host, Icon. Descr. Gram. Austriac. 4:15. 1809 (lectotype, designated by R. Ross, Acta Bot. Neerl. 15:157. 1966).

Plants annual or perennial; usually synoecious, sometimes dioecious; caespitose, stoloniferous, or rhizomatous; flowering culms (2–)5–150 cm tall, not woody, erect, decumbent, or geniculate, sometimes rooting at the lower nodes, simple or branched; internodes solid or hollow; bud initiation intravaginal, rarely extravaginal. Leaf sheaths open, often with tufts of hairs at the apices, hairs 0.3–9 mm long; ligules usually membranous and ciliolate or ciliate, cilia sometimes longer than the membranous base, occasionally of hairs or membranous and non-ciliate; blades flat, folded, or involute. Inflorescences terminal, sometimes also axillary, simple panicles, open to contracted or spike-like, terminal panicles usually exceeding the upper leaves; pulvini in the axils of the primary branches glabrous or hairy; branches not spike-like, not disarticulating. Spikelets 1–20 mm long, 0.5–4.5 mm wide, laterally compressed, with 2 to 40 florets; disarticulation below the fertile florets, sometimes also below the glumes, acropetal with deciduous glumes and lemmas but persistent paleas, or basipetally with the glumes often persistent and the florets usually falling intact; glumes usually shorter than the adjacent lemmas, usually 1(3)-nerved, not lobed, apices obtuse to acute, unawned; calluses glabrous or sparsely pubescent; lemmas usually glabrous, obtuse to acute, 3(5)-nerved, usually keeled, unawned or mucronate; paleas shorter than the lemmas, longitudinally bowed-out by the caryopses, 2-keeled, keels usually short or long ciliate, intercostal region membranous or hyaline; stamens 2 or 3; ovaries glabrous; styles free to the bases. Cleistogamous spikelets occasionally present, sometimes on the axillary panicles, sometimes on the terminal panicles. Caryopses variously shaped; hilum short; embryo with an epiblast, scutellar tail, and elongated mesocotyl internode (formula P+PF), endosperm hard. Chromosome base number of $x = 10$, $2n = 20, 40, 50, 60, 80, 100$, and 108; 2, 4, 5, 6, 8, and 10 ploid (Watson & Dallwitz 2008).

Anatomical and biochemical features.—All species of *Eragrostis* that have been examined anatomically exhibit "Kranz" or C_4 leaf anatomy [except *E. walteri* Pilg. from South Africa, which exhibits C_3 leaf anatomy; see Ellis (1984)], and species have either chloridoid bicellular microhairs (with the broad, short terminal cell the same thickness as the basal cell) or panicoid bicellular microhairs (with a long, thin-walled terminal cell) [Amarasinghe & Watson 1990]. Apparently, three C_4 biochemical types exist in *Eragrostis*: NAD-ME (nicotinamide adenine dinucleotide co-factor malic enzyme), PCK (phosphoenolpyruvate carboxykinase), and intermediates (Prendergast et al. 1986).

Taxonomic position.—The genus *Eragrostis* is placed in tribe Eragrostideae, which in the New World includes three small subtribes (Cotteneinae, Uniolinae, and Eragrostidinae) that diverge as a clade at the base of the chloridoids (Peterson et al. 2007). Character trends in the Eragrostideae include spikelets with many florets, lemmas with 3 to 13-nerves, and many species adapted to xeric habitats. In the New World the Eragrostidinae includes two native genera: *Eragrostis* with 111 species (86 native to New World); and *Steirachne* Ekman with two species (Peterson 2003; Peterson et al. 2007). The Eragrostidinae is characterized by hairy or glabrous culm nodes, hairy or glabrous rachillas, entire lemma apices that are awnless, mucronate, or short-awned (only in the latter two genera), glabrous or scabrous lemmas that are (1)3(5)-nerved, and short basal microhair cells (15–75 µm) on the abaxial epidermis of the leaf blade. Morphologically, the two species of *Steirachne* [*S. barbata* (Trin.) Renvoize and *S. diandra* Ekman] are hardly separable from *Eragrostis acutiflora,* as all have acuminate to attenuate or subaristate, 3-nerved lemmas (Peterson et al. 2007). However, the lemmas of the two species of *Steirachne* have more pronounced setulose lemmas and elongate caryopsis (Renvoize 1984).

Monophyly of Eragrostis.—Based on nuclear and plastid DNA sequences, Ingram and Doyle (2003, 2004, 2007) tested the monophyly of *Eragrostis* and found that, with the inclusion of *Acamptoclados* Nash (*E. sessilispica* Buckley), *Diandrochloa* De Winter, *Neeragrostis* Bush, and *Pogonarthria* Stapf, the genus is indeed monophyletic. However, only 37 species of *Eragrostis* were included in their analysis, so any infrageneric interpretations were beyond the scope of their work.

Infrageneric classification.—Based on spikelet disarticulation, Clayton (1974) and Clayton and Renvoize (1986) have arrived at a first approximation to natural groups and have presented a key to sections *Psilantha* (K. Koch) Tzvelev, *Eragrostis*, *Lappula* Stapf, and *Platystachya* Benth. In most taxa native to the Western Hemisphere, disarticulation of the spikelet is acropetal (florets first maturing at the base) and the lemmas fall with the caryopses, leaving paleas attached to the rachilla. The common mode of disarticulation for introduced species from Africa and Asia is basipetally, where the florets near the apex mature first.

Van den Borre and Watson (1994) investigated 53 species of *Eragrostis* and found that anatomical characters, among others, support the recognition of two distinct groups: *Eragrostis* subgen. *Eragrostis* and *Eragrostis* subgen. *Caesiae* Van den Borre & L. Watson. The most comprehensive attempt so far is Lazarides' (1997) treatment of the Australian *Eragrostis*, in which he recognized six groups primarily based on spikelet disarticulation. Lazarides (1997) correlates his classification with Van den Borre and Watson (1994), who recognized subgenus *Eragrostis* and subgenus *Psilantha*, and with Amarasinghe and Watson (1990), who investigated microhair morphology within the genus. Cope's (1998) informal treatment of *Eragrostis* for the Flora of Zambesiaca is also comprehensive since he delineates nine species groups based on panicle, lemma, and palea morphology in addition to spikelet disarticulation.

Based on caryopsis morphology, Boechat and Longhi-Wagner (2003) placed 49 of the 53 species of *Eragrostis* that occur in Brazil into the following six groups: smooth-walled (six species), medianly reticulate (14 species), roughly reticulate (10 species), finely reticulate (nine species), alveolate (six species), and striate (four species). Overall morphological features led Peterson and Valdés Reyna (2005) to recognize the following four hypothesized lineages within 26 species of *Eragrostis* from northeastern Mexico: an Old World group, the E. *intermedia* Hitchc. complex, the *E. pectinacea* complex, and the *E. spectabilis* (Pursh) Steud.–*E. secundiflora* J. Presl group.

In addition, recent systematic treatments of *Eragrostis* from Argentina (Nicora 1998), Australia (Lazarides 1997), Bénin (Houinato et al. 2000), Bolivia (Renvoize 1998), Brazil (Boechat & Longhi-Wagner 2000, 2001), Congo (Kami 1993), Costa Rica (Pohl 1980), Côte-d'Ivoire (Poilecot 1995), Ecuador (Peterson 2001), France (Portal 2002), Guianas (Judziewicz 1991), Malesia (Veldkamp 2002), Mesoamerica (Davidse 1994), Mexico (Beetle et al. 1991; Peterson & Valdés Reyna 2005), Niger (Poilecot 1999), Peru (Tovar 1993; Peterson & Sánchez Vega 2007), the United States and Canada (Peterson 2003), Venezuela (Graterol et al. 1989), and Zambesiaca (Cope 1998) have given us a good understanding of the species limits and their distribution. However, there is no definitive treatment of the infrageneric classification of the entire genus.

Etymology.—The origin of the name is somewhat obscure. Nathaniel M. von Wolf (1776), who first named *Eragrostis*, made no statement concerning the origin of its name. Clifford (1996) provides three possible derivations: from "eros" (love), and "Agrostis" (the Greek name for an indeterminate herb); from the Greek "er" (early) and "agrostis" (wild), referring to the fact that some species of *Eragrostis* are early invaders of arable land; or the Greek "eri-" (a prefix meaning "very" or "much"), suggesting that the name means many-flowered "*Agrostis*." Watson and Dallwitz (2008) indicate that the derivation of *Eragrostis* is "from the Greek 'eros' (love) or 'era' (earth) and 'agrostis' (a grass), probably alluding to the characteristic, earthy (human) female aroma of the inflorescences of many species."

Ecology and geographic distribution.—The 25 species of *Eragrostis* in Colombia are widely distributed among the coast (mainly Caribbean coast), Andean mountains, llanos, forest regions, cultivated fields, and city sidewalks. The annual species are more conspicuous along the sandy plain of the coast, the interior valleys of the western slopes, and in the dry Andean valleys at lower elevations. Along the north coast, *E. tenella*, *E. ciliaris*, *E. cilianensis*, *E. hypnoides*, and *E. viscosa* form part of the xerophytic vegetation.

The mountains species of *Eragrostis* are an integral component of natural, mid to high elevation ecosystems. *Eragrostis nigricans* and *E. pilosa* are usually found growing along margins of cultivated fields while many other species inhabit the edges of roads and trails. *Eragrostis lurida*, and *E. pastoensis*, are principally found in the altiplano, and disappear in the páramos. In the mountainous region of central and southern Colombia there is a greater number of perennial, native species of *Eragrostis*. *Eragrostis hypnoides* is the only species commonly found along the coast and in the Amazonian forest in areas that are periodically flooded, i.e., margins of rivers.

Caryopsis morphology.—The caryopsis contains many morphological features that are important aids in the identification of species and this information can be used to infer hypothetical relationships among the grasses (Boechat & Longhi-Wagner 2003; Colbry 1957; Peterson et al. 2007; Terrell & Peterson 1993). In *Eragrostis*, grains can be terete, subterete, rectangular or trigonous in cross-section, and are sometimes compressed either dorsally (on a plane with the embryo) or laterally (Peterson & Sánchez Vega 2007). The shape of the grain can vary from spherical to much longer that broad (ellipsoid, obovoid, ovoid, rectangular-prismatic, etc.). The embryo is located on the dorsal (abaxial) surface of the grain and the hilum is the tiny scare left from the attachment of the funiculus found near the base on the ventral surface. The ventral (adaxial) surface can be rounded, flattened or sometimes have a sulcus or groove running longitudinally along the body. The surface of the grain can be smooth to variously sculptured and is often striate to reticulate. In the grasses the surface or pericarp of the grain is almost always adnate, i.e., a true caryopsis; however, a few species of *Eragrostis* (see *E. japonica*) can have loose pericarps that shed when the grain is moistened. Color of the grain can vary from light brownish or whitish to reddish brown, and the grains can be translucent to opaque.

The most common caryopsis type found in Colombian *Eragrostis* is the rectangular-prismatic to irregularly triangular, laterally-flattened, striate, reticulate-walled, and ventrally-grooved grain. This is found predominately in species that occupy the altiplano such as *E. lurida* and *E. pastoensis*, as well as in *E. lugens*, *E. mexicana*, *E. nigricans*, and *E. tenuifolia* (of African origins). *Eragrostis pectinacea* and *E. pilosa* are similar to the last group, although these two species have grains that are striate only and are rectangular in cross-section, so they are at least flattened ventrally but do not have a groove. *Eragrostis maypurensis* is unique in possessing rhomboid reticulations without striations. *Eragrostis tenella*, *E. cilianensis*, *E. ciliaris*, *E. curvula*, *E. hypnoides*, *E. japonica*, and *E. maypurensis* are all circular or elliptical to ovate/obovate in cross-section. *Eragrostis tenella*, *E. ciliaris*, *E. curvula*, and *E. japonica* are striate or smooth with no evidence of reticulations. *Eragrostis ciliaris*, *E. japonica*, *E. pilosa*, and *E. curvula* all have somewhat dorsally flattened caryopses. *Eragrostis curvula* in addition to being strongly dorsally-flattened, can sometimes possess a shallow and broad ventral groove.

Economic importance.—The following Colombian species of *Eragrostis* are weedy around the World: *E. cilianensis*, *E. curvula*, *E. japonica*, *E. mexicana*, *E. pectinacea*, *E. pilosa*, *E. tenella*, *E. tenuifolia*, and *E. viscosa*. *Eragrostis tef* (Zucc.) Trotter and *E. curvula* are cultivated, and *E. superba* Peyr., a drought resistant species, is used primarily for reseeding denuded land (Watson & Dallwitz 2008). *Eragrostis tef* is a staple cereal in Ethiopia, which is potentially of wide interest (Watson & Dallwitz 2008). *Eragrostis cilianensis*, *E. ciliaris*, *E. curvula*, *E. pastoensis*, *E. pilosa*, and *E. tenuifolia* are important pasture elements in Colombia (Watson & Dallwitz 2008; pers. obs.).

KEY TO THE SPECIES OF *ERAGROSTIS* IN COLOMBIA

1. Plants annual, caespitose or mat-forming, without innovations.
 2. Stamens 2; pedicels 0.1–1 mm long, mostly shorter than the spikelets.
  3. Palea keels prominently ciliate, the cilia 0.2–1 mm long; spikelets 1.8–3.3 mm long, 6–11-flowered; lower glumes 0.7–1.2 mm long; upper glume 1–1.6 mm long; lemmas 0.8–1.3 mm long **5. E. ciliaris** var. **ciliaris**
  3. Paleas keels smooth to scabrous, the scabridities less than 0.2 mm long; spikelets 6–15(–21) mm long, 10–43-flowered; lower glumes 1.4–2.5 mm long; upper glume 1.5–2.6 mm long; lemmas 1.6–2.3 mm long **21. E. rufescens**
 2. Stamens 3; pedicels usually 1–4(–7) mm long, as long or longer than the spikelets.
  4. Palea keels prominently ciliate, the cilia 0.2–1 mm long.
   5. Plants viscid with particles of soil adhering to the sticky areas along the sheaths, culms, and blades; spikelets (2–)2.5–5.5 mm long **25. E. viscosa**
   5. Plants not viscid and without particles of soil adhering to vegetative portions.
    6. Paleas orbicular, winged **14. E. mokensis**
    6. Paleas obtuse, acute to truncate, not winged.
     7. Spikelets (1–)1.5–2.2 mm long **23. E. tenella**
     7. Spikelets 5–20 mm long **4. E. cilianensis**
  4. Paleas smooth to scabrous, the scabridities less than 0.2 mm long.
   8. Plants mat-forming; panicles 1–3.5 cm long; erect portion of culms (2–)5–20 cm, tall, the basal portion prostrate and rooting at the nodes **47. E. hypnoides**
   8. Plants not forming mats; panicles 3–55 cm long; culms 15–130 cm tall, not prostrate or rooting at the lower nodes.
    9. Ligules membranous, glabrous **9. E. japonica**
    9. Ligules ciliate with a row of tiny white hairs.
     10. Lemmas with 1–3 crateriform glands on the keels; spikelets 2–4 mm wide; disarticulation of entire florets from persistent rachilla **4. E. cilianensis**
     10. Lemmas without crateriform glands; spikelets 0.6–2.5(–3) mm wide; disarticulation of the lemmas only, palea and rachilla usually persistent.
      11. Lemmas acuminate, the apices recurved, chartaceous; pulvini (axils of the primary branches) densely pilose, the hairs up to 4 mm long **12. E. maypurensis**
      11. Lemmas acute to obtuse, the apices never recurved, membranous; pulvini usually glabrous to sparsely ciliate, the hairs if present less than 1.5 mm long.
       12. Caryopses with a shallow or deep adaxial groove.
        13. Spikelets not arranged in glomerules, 5–11(–15)-flowered, (4–)5–10(–11) mm long; pedicels appressed to narrowly divergent, stiff **13. E. mexicana**
        13. Spikelets arranged in glomerules, 2–4(–5)-flowered, 2.6–3.8 mm long; pedicels spreading, divaricate and stout **15. E. nigricans**
       12. Caryopses without an adaxial groove.
        14. Lower glumes 0.5–1.5 mm long, at least 1/2 as long as the lowest lemmas; spikelets 1.2–2.5 mm wide; panicle branches solitary or paired at the lowest 2 nodes; lemmas with moderately conspicuous lateral veins **17. E. pectinacea** var. **pectinacea**

14. Lower glumes 0.3–0.6(–0.8) mm long, usually less than 1/2 as long as the lowest lemmas; spikelets 0.6–1.4 mm wide; panicle branches usually whorled at the lowest 2 nodes; lemmas with inconspicuous lateral veins **18. E. pilosa** subsp. **pilosa**

1. Plants perennial, sometimes rhizomatous, forming innovations at the basal nodes.

15. Spikelets 1.3–2 mm long with 1 or 2, rarely 3 florets **2. E. airoides**

15. Spikelets 2–23 mm long with 2 to many florets.

16. Stamens 3; caryopses usually with a shallow or deep adaxial groove.

17. Glumes not keeled, very unequal, the lower 0.2–0.6 mm long **24. E. tenuifolia**

17. Glumes keeled, equal to subequal, the lower 0.6–2.6 mm long.

18. Lemmas with lateral veins conspicuous.

19. Caryopses 1–1.7 mm long; upper glumes 2–3 mm long **6. E. curvula**

19. Caryopses 0.5–0.8 mm long; upper glumes 1.1–2 mm long.

20. Panicles with the primary branches not floriferous near base; secondary branches composed of loosely overlapping spikelets; pedicels 1.4–7 mm long **10. E. lugens**

20. Panicles with the primary branches floriferous near base; secondary branches condensed into tightly glomerate lobes of spikelets; pedicels 0.1–1 mm long **11. E. lurida** subsp. **lurida**

18. Lemmas with lateral veins inconspicuous.

21. Secondary panicle branches with spikelets appressed to the main axis; pedicels 0.5–3(–5) mm long **16. E. pastoensis**

21. Secondary panicle branches with spikelets diverging 50–90° from the main axis; pedicels (2–)4–16 mm long.

22. Lemmas 1.2–1.8 mm long; blades densely hairy on adaxial surface; anthers 0.3–0.5 mm long **19. E. polytricha**

22. Lemmas (1.6–)1.8–2.3 mm long; blades glabrous to sparsely hairy on adaxial surface; anthers 0.5–0.8 mm long **8. E. intermedia**

16. Stamens 2; caryopses without an adaxial groove.

23. Lemma apices acuminate-attenuate to subaristate; pulvini with hairs.

24. Spikelets 2.4–5 mm wide; glumes 1.7–4 mm long; lemmas 2–6 mm long **22. E. secundiflora** subsp. **secundiflora**

24. Spikelets 1–3 mm wide; glumes 1–2.8 mm long; lemmas 2–2.6 mm long.

25. Lemma apex recurved, yellowish-orange to greenish; spikelets 7–30 mm long; pedicels 0.3–1 mm long, appressed to the branches; upper glumes 1.5–2.8 mm long **12. E. maypurensis**

25. Lemma apex straight, not recurved, greenish to purplish; spikelets 5–7(–10) mm long; pedicels 1–5 mm long, diverging 30–70° from the branch axis; upper glumes 1.4–2 mm long **1. E. acutiflora**

23. Lemma apices acute, occasionally slightly narrowed but never acuminate-attenuate; pulvini glabrous, rarely with a few hairs.

26. Spikelets 2.4–5 mm wide; glumes 1.7–4 mm long; lemmas 2–6 mm long **22. E. secundiflora** subsp. **secundiflora**

26. Spikelets 0.7–2(–2.2) mm wide; glumes 1–1.8(–2) mm long; lemmas 1.5–2.2 mm long.

27. Primary branches with spikelets congested or clustered near the base; spikelets 0.7–1.4 mm wide; anthers 0.2–0.3 mm long; caryopses flattened ventrally **20. E. prolifera**

27. Primary branches naked near base, without a cluster of spikelets; spikelets 1.3–2(–2.2) mm wide; anthers 0.4–0.6 mm long; caryopses rounded, not flattened ventrally **3. E. bahiensis**

1. Eragrostis acutiflora (Kunth) Nees, Fl. Bras. Enum. Pl. 2:501–502. 1829. (**Fig. 1, A–C**). *Poa acutiflora* Kunth, Nov. Gen. Sp. 1:161. 1815 (1816). Type: COLOMBIA: on the Río Magdalena, *F. Humboldt & A. Bonpland 1603* (holotype: P!; isotypes: B-W, P, US-2891479 fragm. ex P!).

Caespitose perennials. Culms 20–65 cm tall, erect to geniculate spreading, glabrous and shiny below the nodes. Leaf sheaths 1/3 to about as long as the internodes, glabrous, ciliate at the summit; ligules 0.1–0.3 mm long, ciliolate-membranous; blades 10–20(–25) cm long, 1.5–4.2 mm wide, flat, occasionally involute, glabrous below, scaberulous above and sparingly ciliate near base. Panicles 8–32 cm long, 2–14 cm wide, open to somewhat contracted; the ascending primary branches 1–10 cm long, somewhat densely flowered, spreading 20–80° from the rachises; pulvini in axils of primary branches pilose; pedicels 1–5 mm long, erect, spreading 30–70° from the branch axis, scaberulous. Spikelets 5–7(–10) mm long, (1–)1.2–1.8(–2.2)

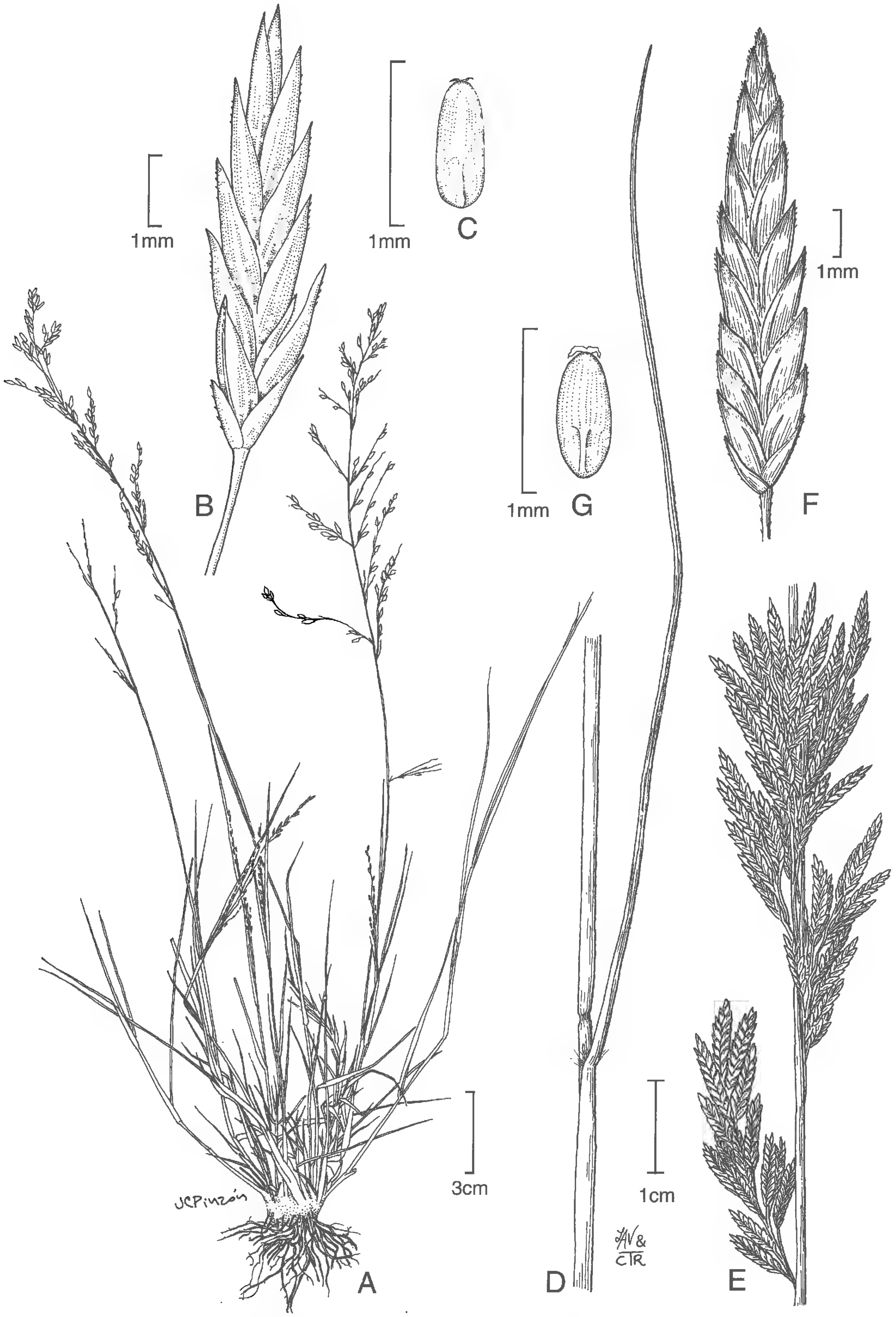
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Fig. 1. *Eragrostis acutiflora* (*N.C. Fassett 25306*). **A.** Habit. **B.** Spikelet. **C.** Caryopsis, dorsal view. *Eragrostis bahiensis* (*J.M. Idrobo & Galeano 4291*, G). **D.** Culm. **E.** Inflorescence. **F.** Spikelet. **G.** Caryopsis, dorsal view.

mm wide, 7–14(–21)-flowered, narrowly elliptical, acute at both ends, strongly compressed, greenish straw-colored towards the center to reddish-purple tinged near the margins; disarticulation entire floret above the glumes or the lemmas falling individually leaving the paleas on the rachilla; glumes 1–2 mm long, narrowly lanceolate with scaberulous keels; lower glumes 1–1.4 mm long; upper glumes 1.4 mm long; upper glumes 1.4–2 mm long; lemmas 2–2.6 mm long, lanceolate to broadly ovate, chartaceous, keeled, scaberulous along keel, lateral nerves evident; apex acuminate to attenuate or subaristate, scaberulous, often reddish-purple; paleas 1.5–2.1 mm long, bowed out below, hyaline, scaberulous along keels; apex acute; stamens 2, anthers 0.2–0.3 mm long, reddish-brown. Caryopses 0.5–0.9 mm long, obovoid to ellipsoid, finely longitudinally striate, light brownish to reddish-brown. $2n = 40$.

Distribution and habitat.—*Eragrostis acutiflora* ranges from México and the Caribbean through Central America to South America where it has been reported from Bolivia, Brazil, Ecuador, French Guiana, Guyana, Surinam, and Venezuela. It can be found growing in moist savannas, open disturbed areas, and sandy to gravelly roadsides; 0–2000 m.

Specimens examined. **COLOMBIA. Amazonas:** Corregimiento departamental La Pedrera, río Caquetá, alrededores de la quebrada La Tonina, 200–300 m, 18 Jul 1997, *D. Giraldo-Cañas 2703* (COAH, COL). **Antioquia:** Puerto Berrío, ca. 125 m, 11 Jan 1931, *W.A. Archer 1392* (US); Mutatá, 11 km Mutatá-Dabeiba, 250 m, *J. Betancur et al. 378* (COL, HUA, MO); Andes, aeropuerto, 1200 m, 17 Sep 1986, *R.W. Pohl & J. Betancur 15521* (HUA, MO, US); Mun. San Carlos, río San Carlos, 920 m, 13 Oct 1981, *C.I. Orozco 685* (COL). **Arauca:** Mun. Arauca, inmediaciones de las instalaciones de la Universidad Nacional de Colombia, hacienda El Cairo, carretera Arauca-Tame, km 9, 200–300 m, 13 Jun 2003, *D. Giraldo-Cañas 3503, 3510* (COL). **Caquetá:** Mun. La Montañita, corregimiento El Santuario, vereda Las Iglesias, reserva natural privada de la hacienda El Ceilán, 280 m, 27–30 Jun 2005, *D. Giraldo-Cañas 3936* (COAH, COL); Mun. Florencia, Barrio Villa Natalia, grietas de pavimentos y andenes, 280 m, 27–30 Jun 2005, *D. Giraldo-Cañas 3953* (COL); Mun. Florencia, carretera Florencia-Neiva, río Hacha, a la altura del primer puente, 280 m, 27–30 Jun 2005, *D. Giraldo-Cañas 3956, 3958* (COAH, COL). **Casanare:** Mun. El Yopal, sabanas alteradas no inundables, entre el nuevo hospital y la Brigada del Ejército Nacional, 400 m, 3 Nov 2007, *D. Giraldo-Cañas 4148, 4155* (COL); Playones del río Upia, carretera a Villanueva, 300 m, 18 Mar 1986, *J.L. Fernández Alonso 5907* (COL). **Cauca:** Río Patía, 1000 m, 2 May 1935, *H. García-Barriga 4507* (COL). **Chocó:** Hoya del río Atrato, Beté, 50–60 m, 5 Apr 1982, *E. Forero 8901* (COL). **Córdoba:** San Benito, 5 km carretera a San Juan, 35 m, 17 Jul 1973, *J.M. Idrobo 6664* (COL). **Cundinamarca:** Fusagasugá, 1680 m, 26 Mar 1961, *J.M. Idrobo 4507* (COL); Entre Paratebueno y Maya, 19 Jun 1989, *F.O. Zuloaga 4100* (COL, MO). **Guaviare:** Mun. San José del Guaviare, trocha Nuevo Tolima, en cercanías del Batallón José Joaquín París, 250 m, Mar 1996, *D. Giraldo-Cañas & R. López 2574* (COAH, COL, MO). **Huila:** Mun. El Agrado, quebrada La Yaguilda, 700 m, Sep 1986, *J.L. Fernández Alonso 6840* (COL). **La Guajira:** Clausura Nopoipa, en el área inundable, 4,5 km de Uribia rumbo a Maicao, 13 Feb 1963, *C. Saravia 2229-A* (COL, note: *Saravia 2229-A* at US is *E. ciliaris*), 19 Oct 1963, *C. Saravia 2892* (COL). **Magdalena:** Valle del río Cesar, cerca de Los Venados, 60 m, 30 Sep 1961, *A. Dugand 5810* (COL). **Meta:** Mun. Villavicencio, carretera Villavicencio-Aeropuerto, piedemonte de la Cordillera Oriental, sitio La Arenera, 2 km del puente sobre el río Guatiquía, 400 m, 10 Nov 2002, *D. Giraldo-Cañas 3346* (COAH, COL); along Río Guatiquía, near Villavicencio, ca. 500 m, 18–19 Mar 1939, *E.P. Killip 34410* (US); Carimagua, NW of the research station, ca. 350 m, 19 Sep 1992, *S. A. Renvoize 5422* (COL, US). **Santander:** region about Landázuri, 70 km N of Vélez, ca. 700 m, 9 Jun 1944, *N. C. Fassett 25306* (COL). **Tolima:** Ibagué, planta eléctrica de Mirolindo, 1200 m, 12 Mar 1965, *R. Echeverry 1189* (COL). **Valle del Cauca:** between Uribe and Sevilla, 1100 m, 2 Nov 1983, *J.R.I. Wood 4083* (COL).

2. Eragrostis airoides Nees, Fl. Bras. Enum. Pl. 2: 509–510. 1829. (**Fig. 2, A–C**). *Aira brasiliensis* Raddi, Agrostogr. Bras. 36. 1823. *Sporobolus brasiliensis* (Raddi) Hack., Bull. Herb. Boissier, sér. 2, 4(3):278. 1904. *Agrosticula brasiliensis* (Raddi) Herter, Revista Sudamer. Bot. 6(5–6):145. 1940. TYPE: BRAZIL. Rio de Janeiro, *G. Raddi s.n.* (HOLOTYPE: PI; ISOTYPE: LE).

Airopsis millegrana Griseb., Abh. Königl. Ges. Wiss. Göttingen 19:252. 1874. TYPE: ARGENTINA. TUCUMÁN: in monte Cuesta de Berico, *P.G. Lorentz & G. Hieronymus 842* (HOLOTYPE: GOET; ISOTYPES: BA-38791!, US-76315 fragm.!).

Eragrostis triflora Ekman, Ark. Bot. 11(4):42, t. 4, f. 1. 1912. TYPE: ARGENTINA. MISIONES: Posadas, Bonpland Trans "Mitires Chico," 20 Jan 1908, *E.L. Ekman 714* (HOLOTYPE: S; ISOTYPES: BAA-1100 fragm.!, CORD!, SI!, US-602662!, US-77381 fragm.!).

Caespitose perennials with innovations, without rhizomes, not glandular. Culms 30–110 cm tall, erect, glabrous below the nodes. Leaf sheaths glabrous or pilose, hairs to 5 mm long; ligules 0.1–0.2 mm long; blades 8–22 mm long, (1–)2–4(–5) mm wide, flat to folded, glabrous abaxially, scabridulous adaxially. Panicles 18–70 cm long, 3–25 cm wide, diffuse, ovate; primary branches 4–20 cm, appressed or diverging 10–70° from the rachises, naked basally; pulvini glabrous; pedicels 2.4–11 mm long, divergent. Spikelets 1.3–2 mm long, 0.8–1.8 mm wide, ovate to lanceolate, plumbeous, with 1 or 2, rarely 3 florets; disarticulation acropetal, in the rachilla below the florets, glumes deciduous; rachilla prolonged above the terminal floret; glumes lanceolate to ovate, membranous; lower glumes 0.8–1 mm long; upper glumes 1.1–1.4 mm long;

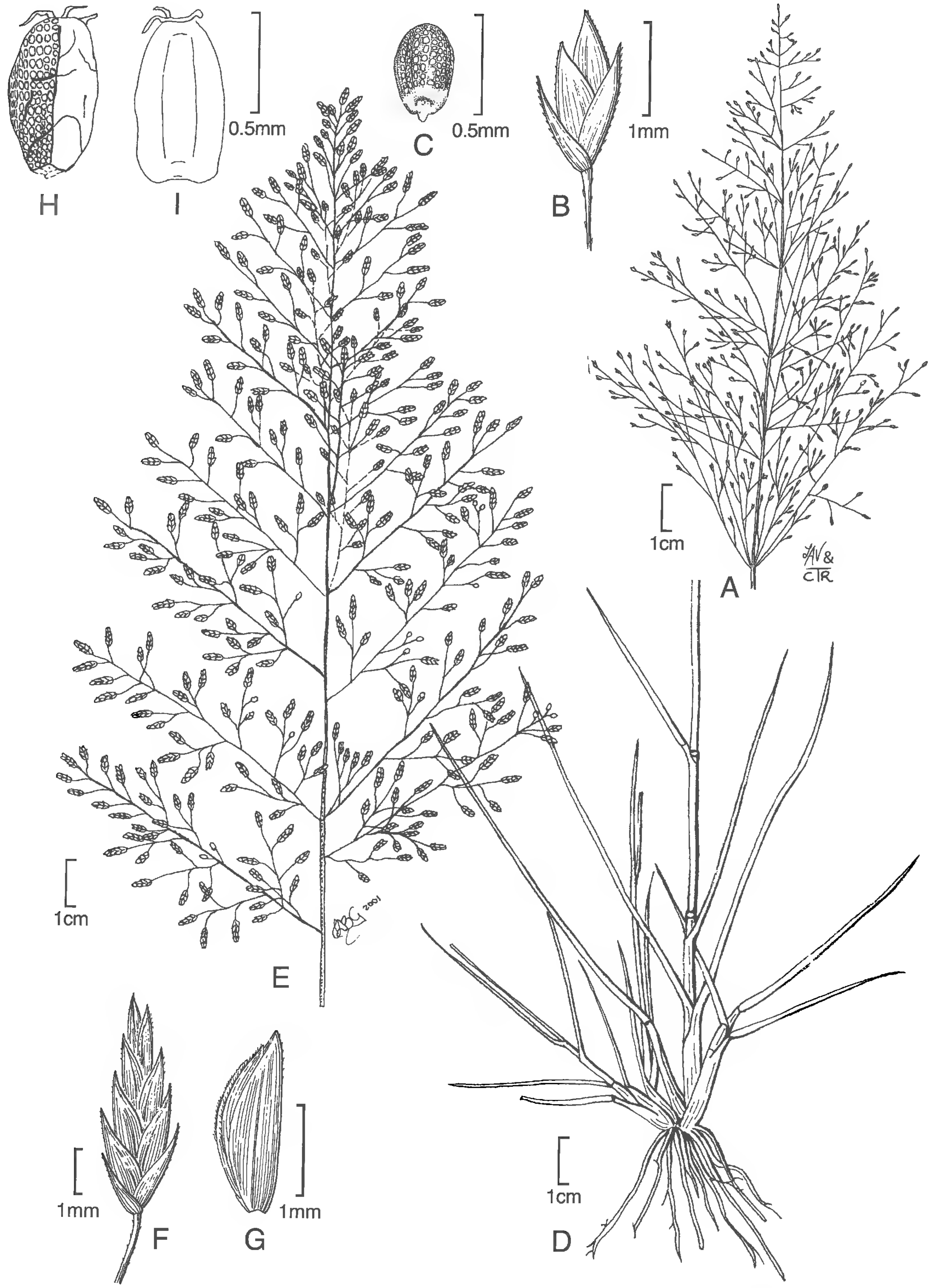
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Fig. 2. *Eragrostis airoides* (*J.D. García 10*, C). A. Inflorescence. B. Spikelet. C. Caryopsis, ventral view. *Eragrostis intermedia* (*Groenendijk & Rietman 1534*, D, E, H, I). D. Habit. E. Inflorescence. F. Spikelet, G. Floret. H. Caryopsis, lateral view. I. Caryopsis, ventral view.

lemmas 0.8–1.2 mm long, ovate, membranous, plumbeous, keels and lateral veins inconspicuous, apices obtuse; paleas 0.8–1.2 mm long, membranous, bases not projecting beyond the lemmas, apices obtuse; stamens 3, anthers 0.3–0.5 mm long, purplish. Caryopses 0.4–0.5 mm long, ovoid, reticulate, reddish-brown. $2n = 36$ (Davidse, pers. comm.).

Distribution and habitat.—*Eragrostis airoides* is a South American species known to occur in Argentina, Bolivia, Brazil, Paraguay, Uruguay, Venezuela, the Caribbean, and introduced Brazos Co., Texas; it is found in open grasslands, savannas, and cerrados (Boechat & Longhi-Wagner 2001).

Comments.—It is an enigmatic species, often treated as *Sporobolus brasiliensis* (Raddi) Hack, which it resembles in its chromosome base number of $x = 9$ and caryopsis morphology, but its frequent possession of spikelets with more than one floret and its mode of spikelet disarticulation argue for its retention in *Eragrostis*.

Specimens examined. **COLOMBIA. Cauca:** Chisquio, ca. 1700 m, 4 Apr 1940, *E. Asplund 10776* (US); Río Sucio to Río Piedras, W of Popayán, 1500–1800 m, 3 Jul 1922, *F.W. Pennell & E.P. Killip 8190* (US); Loma de Bichiquí, near Toribío, Río Páez Basin, Tierradentro, 2000 m, Feb 1906, *H. Pittier 1473* (US). **Norte de Santander:** Abrego, 1300 m, 25 Feb 1943, *J.B. García & Cabrales 10* (COL). **Valle del Cauca:** Pavas, Cordillera Occidental, 1500–1700 m, *E.P. Killip 11636* (US). Unknown department: *J.C. Mutis 5542* (US).

3. Eragrostis bahiensis Schrad. ex Schult., Mant. 2:318. 1824. **(Fig. 1, D–G)**. *Eragrostis pilosa* var. *bahiensis* (Schrad. ex Schult.) Kuntze, Revis. Gen. Pl. 3(2,2):353. 1898. Type: BRAZIL: *Maximilian Neowidensis s.n.* (HOLOTYPE: LE).

Eragrostis expansa Link, Hort. Berol. 1:190. 1827. Type: URUGUAY: Montevideo, *F. Sellow s.n.* (ISOTYPE: US-2850751 fragm.!).

Poa microstachya Link, Hort. Berol. 1:185. 1827. *Eragrostis psammodes* var. *microstachya* (Link) Döll, Fl. Bras. 2(3):153. 1878. *Eragrostis microstachya* (Link) Link, Hort. Berol. 2:294. 1933. Type: URUGUAY: Montevideo, *F. Sellow s.n.* (HOLOTYPE: B; ISOTYPES: BAA-989 fragm. ex B!, US-2850751!).

Eragrostis firma Trin., Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 4,2(1):74. 1836. Type: BRAZIL. São Paulo: inter plantas a St. Paulo (HOLOTYPE: LE-TRIN-2342.01!; ISOTYPE: US-2891470 fragm.!).

Eragrostis blepharophylla Jedwabn., Bot. Arch. 5(3–4):197. 1924. BRAZIL: *F. Sellow 3688* (ISOTYPE: US-2891454 fragm.!).

Eragrostis macra Jedwabn., Bot. Arch. 5(3–4):200. 1924. Type: BRAZIL: Nov 1887, *A.F.M. Glaziou 16624* (LECTOTYPE: US-1280047! designated by Boechat & Longhi-Wagner, Iheringia, Bot. 55:147. 2001; ISOLECTOTYPES: C, US-289924!, US-1280048!).

Eragrostis bahiensis forma *riparia* Burkart, Fl. Il. Entre Ríos 2:189. f.66. 1969. Type: ARGENTINA. Entre Ríos: Concepción del Uruguay, Isla Almirón Chico, *Burkhart & Crespo 22874* (HOLOTYPE: SI; ISOTYPE: BAA-1010!).

Caespitose perennials with innovations, without rhizomes, not glandular. Culms 25–95(–110) cm tall, erect, glabrous. Leaf sheaths glabrous, summits hairy, hairs 1–3 mm; ligules 0.2–0.4 mm long; blades (8)12–40 cm long, 2–5 mm wide, flat to involute, abaxial surfaces glabrous, adaxial surfaces scabridulous and glabrous or long ciliate basally. Panicles 15–30(45) cm long, (4)8–17 cm wide, narrowly ovate, open to contracted; primary branches 5–15 cm long, diverging 20–90° from the rachises, often capillary, usually naked basally; pulvini glabrous; pedicels 0.3–6 mm long, mostly appressed, scabridulous, always shorter than the spikelets. Spikelets 6–15(18) mm long, 1.3–2(2.2) mm wide, narrowly lanceolate, plumbeous, occasionally with a reddish-purple tinge, with 8–30(40) florets; disarticulation usually in the rachilla below the florets, occasionally the lemmas falling separately, leaving the paleas on the rachilla; glumes lanceolate to ovate, membranous to subhyaline, keeled; lower glumes 1–1.4 mm long; upper glumes 1.4–1.7 mm long; lemmas 1.5–2.2 mm, broadly ovate, leathery, scabridulous, lateral veins evident, apices acute; paleas 1.4–2.1 mm long, hyaline, bases not projecting beyond the lemmas, keels scabridulous, apices acute to obtuse; stamens 2, anthers 0.4–0.6 mm long, reddish-purple. Caryopses 0.6–0.8 mm long, obovoid to ellipsoid, terete, somewhat striate, reddish-brown. $2n$ = unknown.

Distribution and habitat.—*Eragrostis bahiensis* grows in sandy soils near river banks, lake shores, and roadsides, at 0–1500 (–1850) m. Its range extends south from the Gulf Coast of the United States through México to Peru, Bolivia, Paraguay, and Argentina.

Specimens examined. **COLOMBIA. Antioquia:** Mun. Cocorná, vereda La Piñuela, carretera Medellín-Bogotá, intersección con la carretera hacia San Francisco, 1000 m, 27 Feb 2005, *D. Giraldo-Cañas 3870* (COL). **Arauca:** Mun. Arauca, inmediaciones de las instalaciones de la Universidad Nacional de Colombia, hacienda El Cairo, carretera Arauca-Tame, km 9, 200–300 m, 13 Jun 2003, *D. Giraldo-Cañas 3498* (COL). **Cauca:** Mun. Popayán, sector norte de la ciudad, Villa del Viento, 1850 m, 20 May 2001, *B.R. Ramírez 14163* (CAUP, COL). **Chocó:** Mun. Quibdó, en un barranco del Barrio Medrano, en inmediaciones de la Universidad Tecnológica del Chocó, 90 m, 6 Nov 2005, *D. Giraldo-Cañas 3974* (COL, HUA); Mun. Quibdó, carretera Quibdó-Guayabal, 23 Feb 1985, *J. Espina 1474* (COL, MO); Hoya del río San Juan, río Tamaná, afluente del San Juan, debajo de Santa Rosa, ca. 150 m, 10 Apr 1979, *E. Forero et al. 4974, 4977* (COL, MO); Quibdó Airport, 50 m, 24 Oct 1985, *J.R.I. Wood 5117* (COL). **Meta:** Mun. Villavicencio, carretera Villavicencio-Aeropuerto, piedemonte de la cordillera Oriental, sitio La Arenera, ca. 2 km del puente sobre el río Guatiquía, ca. 400 m, 10–14 Nov 2002, *D. Giraldo-Cañas 3344* (COAH, COL, HUA); along road to Hac. Rubiales, E of Puerto Gaitán, 90 m, 10 Jun 1995, *S. Lægaard & C. Mayorga 17494* (COL); Margen izquierda del río Guayabero, raudal de La Macarena, Angostura Nro. 1, 350 m, 20 Jan 1959, *P. Pinto & Bischler 327* (COL). **Putumayo:** Mun. Mocoa, alrededores de la población, 650 m, 20 Aug 1986, *B.R. Ramírez 651* (COL, PSO). **Valle del Cauca:** Carretera Dagua-Buenaventura, km 32, 540 m, 6 Feb 1961, *J.M. Idrobo 4291* & Galeano (COL, US).

4. Eragrostis cilianensis (All.) Vignolo ex Janch., Mitt. Naturwiss. Vereins Univ. Wien, n.s., 5:110. 1907. (**Fig. 3, A–E**). *Poa cilianensis* All., Fl. Pedem. 2:246. 1785. *Eragrostis megastachya* var. *cilianensis* (All.) Asch. & Graebn., Syn. Mitteleur. Fl. 2:371. 1900. *Eragrostis cilianensis* (All.) F.T. Hubb., Philipp. J. Sci. 8(3):59–161. 1913. *Erosion cilianense* (All.) Lunell, Amer. Midl. Naturalist 4:221. 1937. *Eragrostis multiflora* var. *cilianensis* (All.) Maire, Bull. Soc. Hist. Nat. Afrique N. 30: 369. 1939. TYPE: ITALY. Ciliani, *Bellardi s.n.* (LECTOTYPE: TO-8242 designated by F. Vignolo, Malpighia 18:380. 1904; ISOTYPES: BRI, K photo neg. 19571!).

Caespitose annuals. Culms 15–45(–65) cm tall, erect or decumbent and prostrate, glabrous and shiny, sometimes with crateriform glands below the nodes. Leaf sheaths 2/3 the length of the internodes above, occasionally longer, glabrous, occasionally glandular, densely ciliate at the summit, the hairs often elongate up to 5 mm long; ligules 0.4–0.8 mm long, ciliate; blades (1–)5–20 cm × (1–)3–5(–10) mm, flat to loosely involute, mostly glabrous below, scaberulous above occasionally with widely spaced elongate hairs, sometimes glandular near margins. Panicles (3–)5–16(–20) × 2–8.5 cm, condensed to open, oblong to ovate, the primary branches 0.4–5 cm long, ascending, appressed or diverging 20–80° from the rachises; pulvini glabrous or ciliate; pedicels 0.2–3 mm long, erect, spreading to appressed. Spikelets 6–20 × 2–4 mm, 10–40-flowered, ovate-lanceolate, florets imbricate, plumbeous to greenish or hyaline; disarticulation acropetal, between the florets from the base upwards, usually the entire floret, rachillas persistent; glumes 1.2–2.6 mm long, subequal, broadly ovate to lanceolate, sub-hyaline, membranous, keeled, usually with crateriform glands along the keel, 1- or 3-nerved, scaberulous towards apex of keel; lower glumes 1.2–2 mm long, usually 1-nerved; upper glumes 1.2–2.6 mm long, often 3-nerved; lemmas 2–2.8 mm long, broadly ovate, membranous, lateral nerves evident, strongly keeled, keels with 1–3 crateriform glands; apex obtuse to acute; paleas 1.2–2.1 mm long, hyaline, keels scaberulous, sometimes ciliate, the cilia less than 0.3 mm long; apex obtuse to acute; stamens 3, anthers 0.2–0.5 mm long, yellow. Caryopses 0.5–0.7 mm long, globose to broadly-short ellipsoid, striate and reticulate, circular to elliptical in cross-section, reddish-brown. $2n = 20, 40$ (Bir & Sahni 1988).

Distribution and habitat.—Native to Europe; introduced in southern Canada, U.S.A, México, Central America, Caribbean, Argentina, Bolivia, Brazil, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela (Peterson 2001; Peterson & Boechat 2001); a weed near cultivated fields, pastures, roadsides, and disturbed habitats; 0–3000 m.

Specimens examined. **COLOMBIA. Bogotá D.C.:** Bogotá, La Picota, granja experimental, Tunjuelo, 2650 m, 6 Apr 1941, *H. García-Barriga 10519* (COL); border between **Cesar, Norte de Santander, and Santander:** 20 kilómetros al sur de Abrego, Las Jurisdicciones, Cerro de Oroque, 3700–3960 m, 19–21 May 1969, *H. García-Barriga & R. Jaramillo-Mejía 19723* (COL, US). **Cundinamarca:** Tocaima, 400 m, no date, *C. Saravia 4719* (COL). **Huila:** Río Cabrera, 2 km below confluence of Río Ambicá, 3 km WSW of Colombia, 1000 m, 15 Dec 1942, *F.R. Fosberg 19318* (US); Garzón-Neiva, 400 m, no date, *F.C. Lehmann 8742* (US). **Nariño:** Mun. Pasto, Panamericana, puente del Juanambú, 1000 m, 7 Nov 1987, *B.R. Ramírez 1037* (COL, PSO). **Valle del Cauca:** Río Calima, región del Chocó, margen derecha, lomas frente a Quebrada de la Brea, 30–50 m. 18 May 1946, *J. Cuatrecasas 21067* (COL, US); Cartago, Santa Ana de los Caballeros, 950 m,19 Nov 1946, *J. Cuatrecasas 23024* (COL, US); Yumbo, finca Río Grande, bosque El Ramón, 1600 m, 13 Jun 1998, *D. Stancik 783* (COL).

5. Eragrostis ciliaris (L.) R. Br. Narr. Exped. Zaire 478. 1818. var. **ciliaris** (**Fig. 3, F–J**). *Poa ciliaris* L., Syst. Nat. (ed. 10) 875. 1759. *Megastachya ciliaris* (L.) P. Beauv., Ess. Agrostogr. 74, 167, 174. 1812. *Cynodon ciliaris* (L.) Raspail, Ann. Sci. Nat., Bot. 5:302. 1825. *Eragrostis ciliaris* (L.) Nees, Fl. Bras. Enum. Pl. 2:512–514. 1829. TYPE: JAMAICA: *Browne s.n.* (LECTOTYPE: LINN 87.66! designated by Hitchcock, Contr. U.S. Natl. Herb. 12:121. 1908).

Caespitose annuals. Culms (3–)9–75 cm tall, erect or geniculate in the lower portion, not rooting at the lower nodes, glabrous. Leaf sheaths 1/2–3/4 as long as the internodes, hairy on the margins and at the apices, hairs to 4 mm long; ligules 0.2–0.5 mm long; blades 1.8–12(–15) cm × 2–5 mm, usually flat, occasionally involute, glabrous or ciliate basally. Panicles 1.7–17 × 0.2–1.5 cm, cylindrical, contracted, spike-like, branches forming

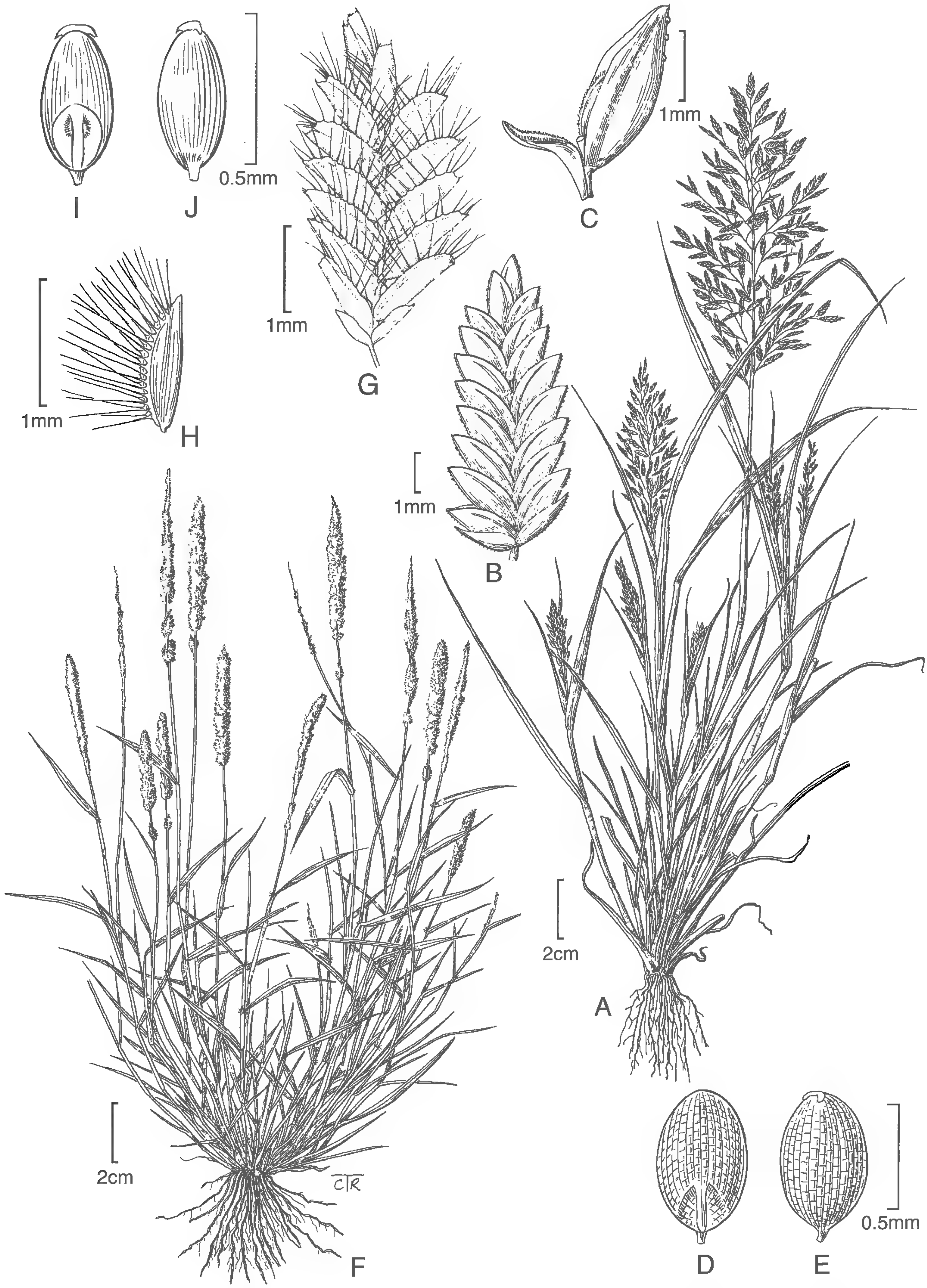
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Fig. 3. *Eragrostis cilianensis* (*R. Ferreyra 6017*, D & E). **A.** Habit. **B.** Spikelet. **C.** Floret with palea attached below. **D.** Caryopsis, dorsal view. **E.** Caryopsis, lateral view. *Eragrostis ciliaris* (*M. Schnetter & R. Schnetter 112*, G; *A. Sagástegui A. 10927*, I & J). **F.** Habit. **G.** Spikelet. **H.** Floret. **I.** Caryopsis, dorsal view. **J.** Caryopsis, lateral view.

glomerate lobes or sometimes more open, often interrupted in the lower portion; primary branches 0.4–4 cm, ascending, tightly appressed; pulvini usually glabrous, occasionally sparsely pilose; pedicels 0.1–1 mm long, erect, shorter than the spikelets, glabrous. Spikelets 1.8–3.2 × 1–2 mm, 6–11-flowered, elliptical-ovate to ovate-lanceolate, yellowish-brown, sometimes with a purple tinge, densely packed next to one another forming glomerate lobes; disarticulation basipetal, glumes persistent; glumes 0.7–1.6 mm long, subequal, ovate to lanceolate, keels scabridulous, veins commonly green, apices acute; lower glumes 0.7–1.2 mm long; upper glumes 1–1.6 mm long; lemmas 0.8–1.3 mm long, elliptical-ovate to lanceolate, membranous, keels scabridulous, lateral veins evident; apex obtuse to acute; paleas 0.8–1.3 mm long, membranous, keels prominently ciliate, cilia 0.2–0.8 mm long, stiff and pectinate-thickened near base; apex obtuse to acute; stamens 2, anthers 0.1–0.3 mm long, purplish. Caryopses 0.4–0.5 mm long, ovoid, striate, slightly dorsally-flattened, elliptical in cross-section, reddish-brown. $2n = 20, 40$ (Bir & Sahni 1988).

Distribution and habitat.—Apparently native to the paleotropics; introduced and naturalized in México, U.S.A., Central America, Caribbean, Argentina, Bolivia, Colombia, Ecuador, Guianas, Paraguay, Peru, and Venezuela (Nicora 1998; Peterson & Boechat 2001); growing along roadsides, on waste sites, in xerothermic vegetation, saline habitats, and city sidewalks; 0–1600 m.

Specimens examined. **COLOMBIA. Antioquia:** Mun. Medellín, predios de la Plaza de Botero, 1550 m, 4 Jan 2003, *D. Giraldo-Cañas 3429* (COL); Medellín, Facultad de Agronomía, 1500 m, 10 Jul 1947, *W.H. Hodge 6933* (US); Medellín, 1550 m, 22 Apr 1927, *R.A. Toro 239* (US). **Arauca:** Mun. Arauca, inmediaciones de las instalaciones de la Universidad Nacional de Colombia, hacienda El Cairo, carretera Arauca-Tame, km 9, 200–300 m, 13 Jun 2003, *D. Giraldo-Cañas 3505* (COL). **Atlántico:** Entre Baranoa y Galapa, 80–100 m, 26 Nov 1960, *A. Dugand 5380* (COL, US). **Bolívar:** along Mompós- Juana Sánchez trail, Island of Mompós, Lands of Loba, Apr–May 1916, *H.M. Curran 245* (US); Cartagena, 20 Nov 1912, *A.S. Hitchcock 9898* (US); Tierrabomba Island, Cartagena Bay, 4 Nov 1926, *E.P. Killip & A.C. Smith 14122* (MO, US); Cañabetal, río Magdalena, 90–100 m, 15 Jan 1918, *F.W. Pennell 3882* (MO, US); Cartagena, Caribbean Coast, 0–1 m, 1–3 Oct 1922, *F.W. Pennell 12007* (US). **Casanare:** Mun. El Yopal, en áreas urbanas del centro de la ciudad, 400 m, 31 Oct 2007, *D. Giraldo-Cañas 4133* (COAH, COL); Yopal, 400 m, year 1983, *J.R.I. Wood 3815* (COL). **Córdoba:** Mun. Momil, finca El Paraíso, en potreros, 39 m, 23 Feb 2005, *D. Giraldo-Cañas 3853, 3855* (COL). **Cundinamarca:** Mun. Nilo, hacienda La Guaira, río Pagüey, 350 m, 16 Oct 2004, *D. Giraldo-Cañas 3781* (COL); Mun. Girardot, vía férrea entre Girardot y Flandes, ribera del río La Magdalena, 250 m, 17 Oct 2004, *D. Giraldo-Cañas 3787* (COL); Mun. Nariño, 340 m, 1 Mar 1986, *J.L. Fernández Alonso 5514* (COL). **Huila:** Mun. Villavieja, desierto La Tatacoa, 460 m, 28 May 2000, *B.R. Ramírez 13193* (CAUP, COL). **La Guajira:** Mun. Uribia, corregimiento Nazareth, playa Nueva York, 0–5 m, 6 Jan 2005, *J. Betancur et al. 11369* (COL); Maicao, 31 Mar 1962, *C. Saravia 365* (COL, US); 2.6 km de Monevideo, rumbo a Nazareth, 5 Abr 1962, *C. Saravia & D. Johnson 467* (COL, US); Clausura Nopoipa, rumbo a Maicao, 4.5 km de Uribia, 13 Feb 1963, *C. Saravia 2229* (COL, US), *2229-A* (US, note: *Saravia 2229-A* at COL is *E. acutiflora*); Serranía La Macuira, entre el arroyo y la duna Arehuara, 290 m, 4 Mar 1963, *C. Saravia 2367* (COL, US); Serranía La Macuira, 12 Apr 1964, *C. Saravia & M. E. de Saravia 3544* (COL, MO, US); Riohacha, 6 Feb 1914, *J.G. Sinclair s.n.* (US-865575). **Magdalena:** Río Frío, near sea level, 23 Jun 1906, *H. Pittier 1583* (US); Isla de Salamanca, cerca de la finca Mahoma, 18 Nov 1966, *M. Schnetter & R. Schnetter 112* (COL); Santa Marta, 1898–1901, *H.H. Smith 110* (COL, MO, US). **Meta:** Mun. Villavicencio, carretera Villavicencio-Aeropuerto, piedemonte de la cordillera Oriental, sitio La Arenera, ca. 2 km del puente sobre el río Guatiquía, ca. 400 m, 14–15 Dec 2002, *D. Giraldo-Cañas 3386* (COL); Reserva Nacional de La Macarena, margen izquierda del río Guayabero, al pie de las mesetas con el caño Losada, 300 m, 5 Mar 1959, *R. Jaramillo-Mejía 2108* (COL, MO, US). **Nariño:** Candelillas, 45 m, 10 Aug 1977, *P. Pinto 1923* (COL). **San Andrés, Providencia y Santa Catalina:** Isla de San Andrés, 22–27 Apr 1948, *G.R. Proctor 3265* (US); Alrededores de la cueva de Morgan, 24 Dec 1988, *J.H. Torres 3313-A* (COL). **Santander:** Granja agropecuaria Piedecuesta, al sur de Bucaramanga, 1000 m, 6 Oct 1966, *A. Robinson 3167* (US); Prope Billete Blanco, 4 May 1926, *G. Woronow & S. Juzepczuk 4671* (US); Bajo Magdalena, Isla de Venado, inter Billete Blanco et El Presidio, 7 May 1926, *G. Woronow & S. Juzepczuk 4748* (US). **Tolima:** Mun. Flandes, vía férrea entre Flandes y Girardot, ribera del río La Magdalena, 250 m, 17 Oct 2004, *D. Giraldo-Cañas 3792-A* (COL); Piedras, 430 m, 29 Feb 1876, *E. André 1868* (US). **Valle del Cauca:** Cisneros, río Dagua, 300–500 m, 5 May 1939, *E.P. Killip 35597* (COL, US). **Vichada:** Región Guayanesa, Mun. Puerto Carreño, afloramientos rocosos del tipo lajas, entre Punta de Lajas y Cerro El Bita, ribera del río Orinoco, 40–100 m, 4–5 Jan 2004, *D. Giraldo-Cañas & C. Parra 3621* (COAH, COL).. **Unknown department:** *J.C. Mutis 5482* (US); *Moritz s.n.* (US-557611).

6. Eragrostis curvula (Schrad.) Nees, Fl. Afr. Austral. Ill. 397. 1841. (**Fig. 4, A–E**). *Poa curvula* Schrad., Gött. Gel. Anz. 3:2073. 1821. TYPE: SOUTH AFRICA: Cape Province, Cape of Good Hope, *Hess s.n.* (HOLOTYPE: LE; ISOTYPE: LE-TRIN 2327.01! lower middle specimen).

Caespitose perennials forming innovations at the base; culms (45–)60–150 cm tall, erect, glabrous or glandular. Leaf sheaths 1/3–2/3 the length of the internodes, with scattered hairs, hairs to 9 mm long; ligules 0.6–1.3 mm long, ciliate; blades 12–50(–65) cm × 1–3 mm, flat to involute, abaxial surfaces glabrous, sometimes scaberulous, adaxial surfaces with scattered hairs basally, hairs to 7 mm long. Panicles 16–35(–40) ×

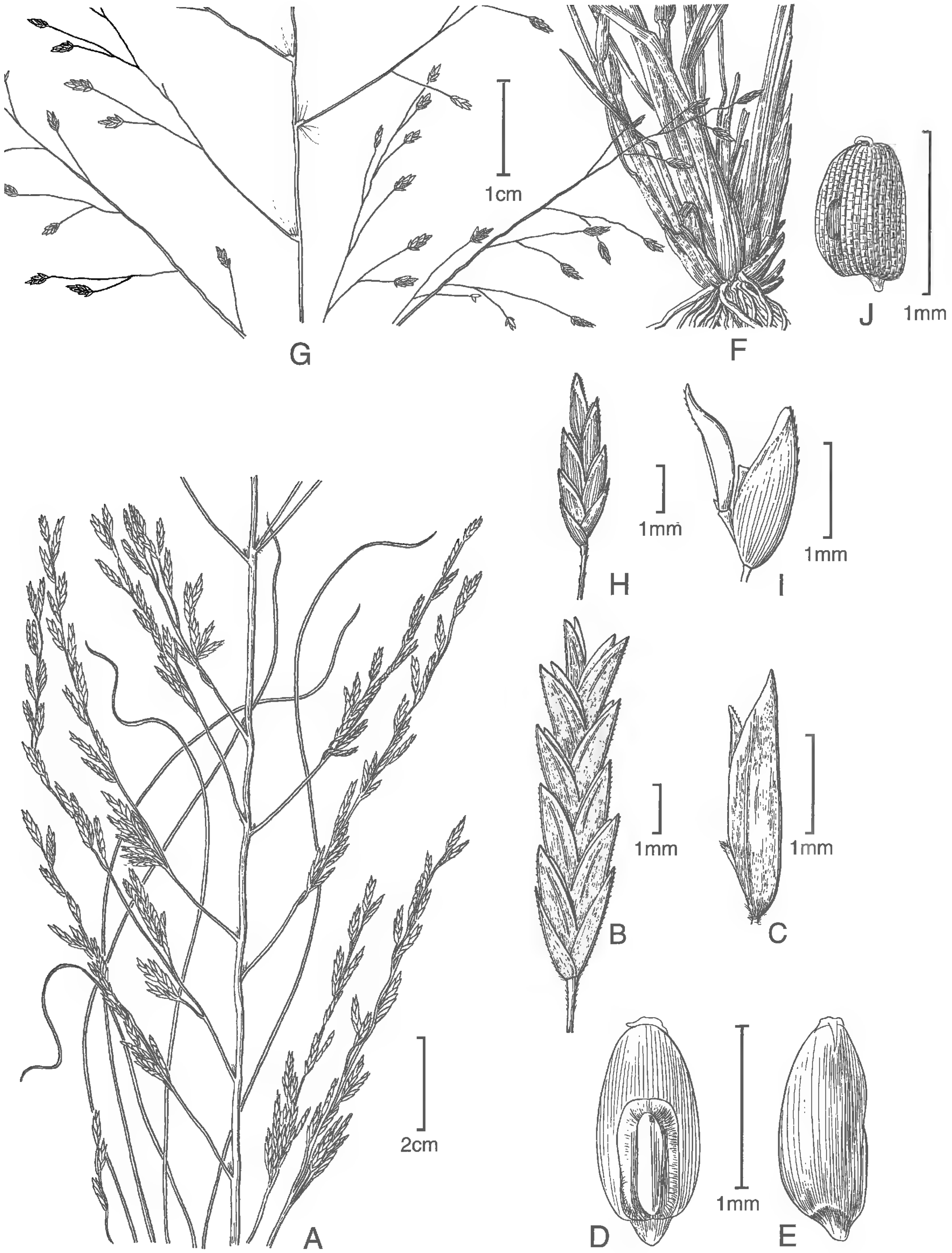
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Fig. 4. *Eragrostis curvula* (*J.R. Reeder & C.G. Reeder 7311*, D & E). **A.** Inflorescence. **B.** Spikelet. **C.** Floret. **D.** Caryopsis, dorsal view. **E.** Caryopsis, lateral view. *Eragrostis lugens* (*I. Sánchez-Vega 3218*, J). **F.** Habit. **G.** Inflorescence. **H.** Spikelet. **I.** Floret with palea attached above. **J.** Caryopsis, lateral view.

(4–)8–24 cm, ovate to oblong. open; primary branches 3–14 cm long, diverging 10–80° from the rachises; pulvini glabrous or not, the hairs up to 3 mm long; pedicels 0.5–5 mm long, appressed, flexible. Spikelets 4–8.2(–10) × 1.2–2 mm, 3–10-flowered, linear-lanceolate, plumbeous to yellowish; disarticulation irregular to acropetal, proximal rachilla segments persistent; glumes 1.2–3 mm long, subequal, lanceolate, hyaline; lower glume 1.2–2.6 mm long; upper glumes 2–3 mm long; lemmas 2–3.2 mm long, ovate, membranous, lateral veins conspicuous; apex acute; paleas 2–3.2 mm long, hyaline to membranous; apex obtuse; stamens 3, anthers 0.8–1.3 mm long, reddish-brown. Caryopses 1–1.7 mm long, ellipsoid to obovoid, strongly dorsally-flattened, ventral surface with a shallow, broad groove or ungrooved, smooth to striate, mostly translucent, elliptical in cross-section, light brown, bases often greenish. $2n = 40, 50, 60, 80$ (de Wit 1954; Spies & Jonker 1987; de Wit 1954).

Distribution and habitat.—Native to southern Africa; introduced in the U.S.A, México, Costa Rica, Argentina, Bolivia, Brazil, Chile, Colombia, Peru, Uruguay, and Venezuela (Nicora 1998; Peterson & Boechat 2001); rocky slopes, margins of woods, roadsides, waste ground, and often used in reclamation; 10–2900 m.

Specimens examined. **COLOMBIA. Valle del Cauca:** Palmira, cultivada (a partir de semillas de la Argentina) en la Granja Agrícola, 1000 m, 19 Jul 1963, *H. S. McKee 10489* (COL, US).

7. Eragrostis hypnoides (Lam.) Britton, Sterns & Poggenb., Prelim. Cat. 69. 1888. (**Fig. 5, A–E**). BASIONYM: *Poa hypnoides* Lam., Tabl. Encycl. 1:185. 1791. *Megastachya hypnoides* (Lam.) P. Beauv., Ess. Agrostogr. 74, 167, 175. 1812. *Neeragrostis hypnoides* (Lam.) Bush, Trans. Acad. Sci. St. Louis 13:180. 1903. *Erosion hypnoides* (Lam.) Lunell, Amer. Midl. Naturalist 4:221. 1915. TYPE: TROPICAL AMERICA: *D. Richard s.n.* (HOLOTYPE: P-LAM!; ISOTYPES: BAA-1041!, NY fragm.ex P!, US-2850742 fragm. ex P!).

Annuals, stoloniferous, mat-forming, without innovations. Culms decumbent and rooting at the lower nodes, erect portion (2–)5–12(–20) cm tall, often branched, glabrous or hairy on the lower internodes. Leaf sheaths 1/3–1/2 as long as the internodes above, pilose on the margins, collars, and at the apices, hairs 0.1–0.6 mm long; ligules 0.3–0.6 mm long, ciliate; blades 0.5–2.5 cm × 1–2 mm, flat to involute, abaxial surfaces glabrous, adaxial surfaces appressed pubescent, hairs ca. 0.2 mm long. Panicles 1–3.5 × 0.7–2.5 cm, terminal and axillary, ovate, open to somewhat congested; primary branches 0.1–0.5 cm long, appressed to strongly divergent, glabrous; pulvini sparsely pilose or glabrous; pedicels 0.2–1 mm long, ciliate. Spikelets 4–13 × 1–1.5 mm, 12–35-flowered, linear-oblong, often arcuate, loosely imbricate, greenish-yellow to purplish; disarticulation acropetal, paleas persistent; glumes 0.4–1.2 mm long, subequal, linear-lanceolate to lanceolate, hyaline; lower glume 0.4–0.7 mm long; upper glume 0.8–1.2 mm long; lemmas 1.4–2 mm long, ovate, strongly 3-nerved, the nerves greenish; apex acuminate; paleas 0.7–1.2 mm long, hyaline, keels scaberulous; apex acute to obtuse; stamens 2, anthers 0.2–0.3 mm long, brownish. Caryopses 0.3–0.5 mm long, ellipsoid, faintly striate and reticulate, laterally-flattened, somewhat translucent, elliptical in cross-section, light brown. $2n = 20$ (Davidse 1981).

Distribution and habitat.—Native to the Americas found in North, Central, and South America (excluding Chile), and the Caribbean (Nicora 1998; Peterson & Boechat 2001); found along muddy or sandy shores of lakes and rivers and moist disturbed sites; 0–1000 m.

Specimens examined. **COLOMBIA. Amazonas:** Loretoyacu, 1 Oct 1943, *C.O. Grassl 10091* (US); Trapecio amazónico, Amazon River, Leticia, 100 m, Sep 1946, *R.E. Schultes 8196* (COL, US); Trapecio Amazónico, Loretoyacu River, 100 m, Oct 1946, *R.E. Schultes & G.A. Black 8497-A* (COL, US). **Amazonas-Caquetá:** Río Caquetá, Araracuara, sabana de la Angostura, 400 m, 21 Dec 1951, *H. García-Barriga & R.E. Schultes 14155* (COL, US). **Amazonas-Vaupés:** Río Apaporis, Soratama, 14 Feb 1952, *R.E. Schultes & I. Cabrera 16103* (COL, US). **Antioquia:** Puerto Berrío, 125 m, 11 Jan 1931, *W.A. Archer 1384* (US). **Atlántico:** Al sur de Barranquilla, río Magdalena, en la isla en frente de Puerto Giraldo, 5–10 m, 29 Apr 1960, *L.E. Mora 1465* (COL). **Arauca:** Mun. Arauquita, vereda La Osa, bloque Caño Limón, plataforma petrolera Chipirón, 150 m, 31 Mar 2008, *G.A. Silva 745* (COL). **Bolívar:** Soplaviento, and vicinity, 5–10 m, 16 Nov 1926, *E.P. Killip & A.C. Smith 14604* (COL, MO, US). **Boyacá-Arauca:** Los Llanos, Río Casanare about 15 km above Rondón, 200 m, 15 Mar 1939, *O. Haught 2677* (US). **Caquetá:** Río Pepeya, Puerto Tokio, 250 m, 1 Mar 1976, *J.M. Idrobo 8597* (COL). **Casanare:** Los Llanos, along Meta, near Orocué, 140 m, 30 Mar 1939, *O. Haught 2721* (COL, MO, US). **Cauca:** Cerca de Puerto Tejada, 1000 m, 14 Aug 1968, *S. Espinal 2380* (COL). **Córdoba:** Mun. Lorica riberas de los estanques de la Estación Piscícola de la CVS (Corporación autónoma regional del valle de los ríos Sinú y San Jorge), ca. 50 m, 22 Feb 2005, *D. Giraldo-Cañas et al. 3847-A* (COL, HUA, US). **Guaviare:** Angostura Nro. 2, margen derecha del río Guayabero, 200 m, 23 Feb 1969, *P. Pinto 1010* (COL). **Meta:** Margen izquierad del río Guayabero, 10 km abajo del caño Lozada, 350 m, 30 Jan 1959, *P. Pinto 365* (COL, US). **Santander:** Río Magdalena, boca del río Sogamoso, 110–120 m, 15 Jan

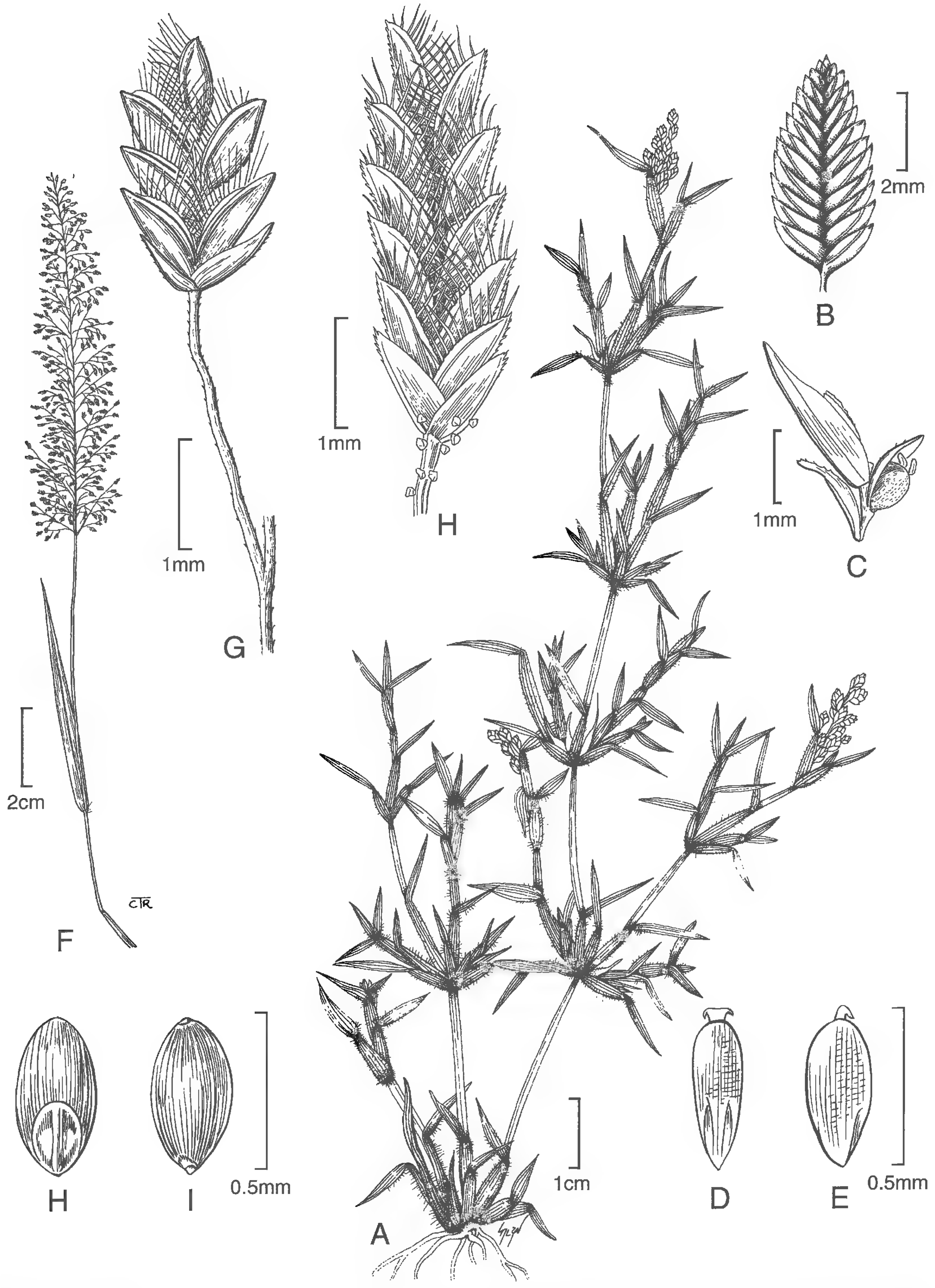

Fig. 5. *Eragostis hypnoides* (*A. López M. & A Sagástegui A. 4023*, D & E). **A.** Habit. **B.** Spikelet. **C.** Floret with two paleas attached below, one with a caryopsis. **D.** Caryopsis, dorsal view. **E.** Caryopsis, lateral view. *Eragrostis tenella* (*S. Llatas Q. 1180, H & I*). **F.** Culm with Inflorescence. **G.** Spikelet. **H.** Caryopsis, dorsal view. **I.** Caryopsis, lateral view. *Eragrostis viscosa* (*O. Haught 4464*). **H.** Spikelet with sand grains attached to pedicel and lower glumes.

1918, *F.W. Pennell 3842* (US). **Valle del Cauca:** Buga, no date, *M. A. Bonpland s.n.* (COL-253787); NE of Cali, near Río Cauca, 1000 m, 3 Mar 1939, *E.P. Killip & G. Varela 34701* (COL, US).

8. Eragrostis intermedia Hitchc., J. Wash. Acad. Sci. 23(10):450. 1933. (**Fig. 2, D–I**). TYPE: U.S.A. TEXAS: Bexar Co.: San Antonio, 3 Jul 1910, *A.S. Hitchcock 5491* (HOLOTYPE: US-1535749!; ISOTYPES: US-908993!, US-1535750!).

Caespitose perennials with innovations, not glandular. Culms (30–)40–90(–110) cm tall, erect, glabrous below the nodes. Leaf sheaths overlapping, ½ to about as long as the internodes below, sparsely pilose on the margins, apices hairy, hairs to 8 mm long, not papillose-based; ligules 0.2–0.4 mm long; blades (4–)10–20(–30) cm long, 1–3 mm wide, flat or involute, abaxial surfaces glabrous, adaxial surfaces densely hairy behind the ligules, elsewhere usually glabrous, occasionally sparsely hairy. Panicles 15–40 cm long, (8.5–)15–30 cm wide, ovate, open; primary branches 4–25 cm long, diverging 20–90° from the rachises, capillary; pulvini hairy or glabrous; pedicels 2–14 mm long, divergent. Spikelets 3–7 mm long, 1–1.8 mm wide, narrowly lanceolate, olivaceous to purplish, with (3–)5–11 florets; disarticulation acropetal, paleas persistent; glumes lanceolate to ovate, hyaline to membranous; lower glumes 1.1–1.7 mm long, narrower than the upper glumes; upper glumes 1.3–2 mm long, apices acuminate to acute; lemmas 1.6–2.2 mm long, ovate, membranous, hyaline near the margins, lateral veins inconspicuous, apices acute; paleas 1.4–2.1 mm long, hyaline, narrower than the lemmas, apices obtuse to acute; stamens 3; anthers 0.5–0.8 mm long, purplish. Caryopses 0.5–1.0 mm long, rectangular-prismatic, somewhat laterally compressed, with a well-developed adaxial groove, striate, opaque, reddish-brown. $2n$ = ca. 54, 60, 72, ca. 74, 80, 100, 120.

Distribution and habitat.—*Eragrostis intermedia* is an American native species, and grows in clay, sandy, and rocky soils, often in disturbed sites; 0–2800 m. Its range extends from the United States through México and Central America to South America.

Comments.—*Eragrostis intermedia* is similar to the more widespread *E. lugens*, but differs from that species in having wider spikelets, longer lemmas, and caryopses with a prominent adaxial groove. A numerical taxonomic study of the *Eragrostis intermedia* complex was completed by Witherspoon (1975) where he found much phenotypic overlap of individuals in his principal component and UPGMA cluster analyses of *E. intermedia* with *E. palmeri* S. Watson, *E. erosa* Scribn. ex Beal, and *E. hirta* E. Fourn. Determination of these species is often problematic and examination of this group, which additionally includes *E. lugens* and *E. hirsuta* (Michx.) Nees, is needed to clarify species boundaries.

Specimens examined. **COLOMBIA. Cundinamarca:** Suesca-Nemocón, vereda Río Checua, hacienda Susatá, en cultivos de Acacia, áreas secas, 2600–2800 m, 7 Jul 2000, *J.L. Fernández et al. 18921-B* (COL), 23 Aug 2000, *J.L. Fernández et al. 19163* (COL); Mun. Suesca, hacienda Susatá, en matorral seco, 2650 m, 8 Sep 1999, *Groenendijk & Rietman 1229* (COL), 26 Nov 1999, *Groenendijk & Rietman 1277* (COL), 15 Nov 1999, *Groenendijk & Rietman 1325* (COL), 2 Aug 2000, *Groenendijk & Rietman 1534* (COL).

9. Eragrostis japonica (Thunb.) Trin., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 1(4):405. 1830. (**Fig. 6, A–D**). *Poa japonica* Thunb., Fl. Jap. 51. 1784. *Eragrostis tenella* var. *japonica* (Thunb.) Roem. & Schult., Syst. Veg. 2:576. 1817. *Diandrochloa japonica* (Thunb.) A.N. Henry, Bull. Bot. Surv. India 9:290. 1968. *Roshevitzia japonica* (Thunb.) Tzvelev, Novosti Sist, Vysš. Rast. 7:50. 1970(1971). TYPE: JAPAN: *Herb. Thundberg 2252* (HOLOTYPE: UPS, microfiche IDC 1036!, K photo!; ISOTYPE: BRI fragm.).

Poa glomerata Walter, Fl. Carol. 80. 1788. *Eragrostis glomerata* (Walter) L.H. Dewey, Contr. U.S. Natl. Herb. 2(3):543. 1894. *Megastachya glomerata* (Walter) Schult., Mant. 2:327. 1824. *Diandrochloa glomerata* (Walter) Burkart, Bol. Soc. Argent. Bot. 12:287. 1968. TYPE: U.S.A. SOUTH CAROLINA: *Walter s.n.* (HOLOTYPE: BM!).

Caespitose annuals. Culms 25–100(–115) cm tall, erect, sometimes geniculate below, branching from the lower and middle nodes, glabrous and somewhat shiny below the nodes. Leaf sheaths 3/4 to 7/8 as long as the internodes above, glabrous at the summit and along the upper margins; ligules 0.4–0.6 mm long, a delicate membrane, glabrous; blades (4–)15–20(–25) cm × 1.5–6 mm, flat, glabrous below and scaberulous above, sometimes auriculate near the base. Panicles 15–40 × 0.8–5 cm, lanceoloid, contracted, interrupted below, the ascending, often appressed primary branches 2–10 cm long, spreading up to 30° from the rachises, the branches scaberulous and shiny, floriferous near base; pulvini glabrous; pedicels 0.5–1.5 mm long, erect and sinuous. Spikelets 2.2–3.8 × 0.8–1.3 mm, 4–12-flowered, oblong to narrowly lanceolate, yellowish-

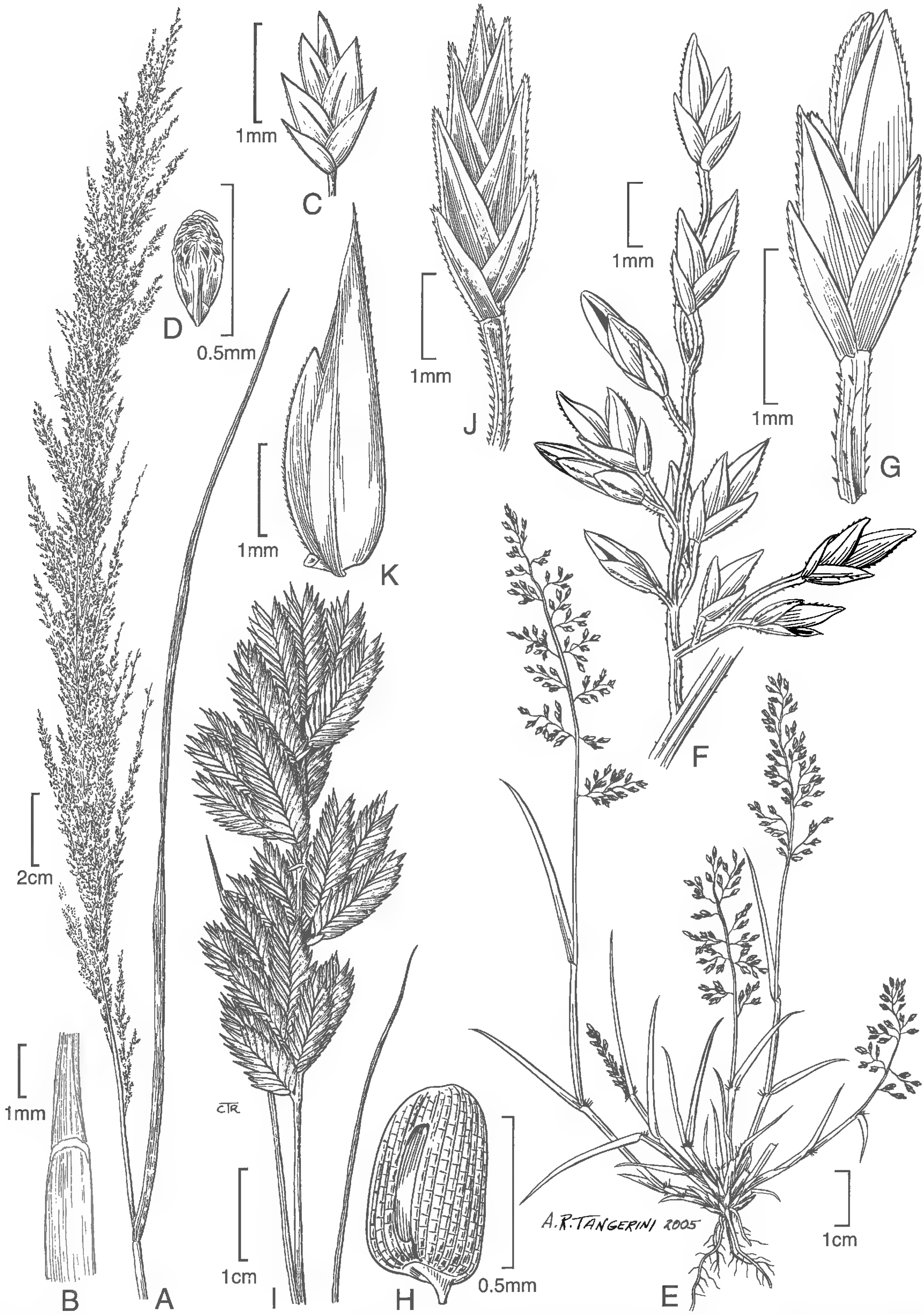
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FIG. 6. *Eragrostis japonica* (*E. Asplund 14802*, D). A. Inflorescence with flag leaf. B. Ligule. C. Spikelet. D. Caryopsis, dorsal view. *Eragrostis nigricans* (*P.M. Peterson & N.F. Refulio-Rodriguez 13855*, E–G; *M.O. Dillon, M. Molau & P. Matekaitis 3258*, H). E. Habit. F. Panicle branch. G. Spikelet. H. Caryopsis, lateral view. *Eragrostis secundiflora* (*W.R. Anderson, M. Stieber & J.H. Kirkbride, Jr. 37109*, K). I. Inflorescence. J. Spikelet. K. Floret.

brown to whitish and hyaline; disarticulation basipetal, the rachillas and glumes persistent; glumes 0.6–1 mm long, subequal, ovate to ovate-lanceolate, hyaline, faintly keeled, scaberulous along the keel; upper glumes without a midnerve; lemmas 0.9–1.2 mm long, ovate, hyaline, the lateral nerves conspicuous below, greenish, keeled, glabrous along the keel; apex acute; paleas 0.6–0.8 mm long, hyaline, scaberulous along the keel near the apex; apex acute, often bifid; stamens 2, anthers 0.1–0.2 mm long, whitish to light brown. Caryopses 0.3–0.4 mm long, obovoid, smooth or minutely irregularly striate, slightly dorsally-flattened, pericarp often loose, elliptical in cross-section, reddish-brown. 2*n* = 20, 60 (Christopher & Abraham 1974; Pohl & Davidse 1971 reported for *E. glomerata*).

Distribution and habitat.—Native in tropical regions of Asia; introduced in U.S.A., México, Central America, Caribbean, Argentina, Bolivia, Brazil, Colombia, Ecuador, Guyana, Paraguay, Peru, Uruguay, and Venezuela (Nicora 1998; Peterson & Boechat 2001); occurs in moist areas along rivers and streams usually in sandy soils; 0–400 m.

Specimens examined. **COLOMBIA. Amazonas:** Río Caquetá, La Pedrera, 240 m, 1–4 Oct 1952, *H. García-Barriga 14586* (COL). **Atlántico:** En la margen derecha del río Magdalena, en frente de Barranqilla, 6 m, 13 May 1960, *L.E. Mora 1498* (COL). **Casanare:** Yopal, hacienda La Milagrosa, 300 m, 10 Nov 1974, *P. Carranza 11* (COL). **Cundinamarca:** No data, 23 Sep 2000, *C. Romero 108* (COL). **Magdalena:** Santa Marta, 1898–1899, *H.H. Smith 111* (COL, MO, US). **Meta:** Llanos, 190 m, 3 Jan 1974, *G. Davidse & F. Llanos 5504* (COL, MO); Llano de San Martín, 250 m, no date, *H. Karsten s.n.* (US-1126597); Llano de San Martín, 250 m, Jan 1856, *J.J. Triana 352* (COL, US). **Tolima:** Saldaña, vereda Baudá, vía Saldaña-Baudá, 360 m, 10 Jul 2002, *A. Osorio 255* (COL). **Vichada:** Entrada del raudal San Borja, Ventanas, 100 m, 17 Mar 1971, *P. Pinto & C. Sastre 1317* (COL, US).

10. Eragrostis lugens Nees, Fl. Bras. Enum. Pl. 2:505–506. 1829. (**Fig. 4, F–J**). *Eragrostis pilosa* var. *lugens* (Nees) Griseb., Abh. Königl. Ges. Wiss. Göttingen 24:290. 1879. Type: BRAZIL: *F. Sellow s.n.* (lectotype: US-732957! designated by Davidse, Fl. Mesoamericana 6:271. 1994; isolectotypes: B, BAA-2932!).

Caespitose perennials forming innovations at base. Culms 30–70 cm tall, erect, sometimes geniculate below, glabrous and somewhat shiny below the nodes. Leaf sheaths 1/2–2/3 as long as the internodes above, ciliate at the summit and along the upper margins; ligules 0.2–0.3 mm long, ciliate; blades (5–)8–22 cm × 1–2(–2.2) mm, involute, rarely flat, mostly glabrous above and below, scaberulous towards the apex and along margins, sometimes with scattered hairs along the margins, the hairs up to 7 mm long. Panicles 16–28 × 10–21 cm, open, ovate, the ascending primary branches 0.6–15 cm long, spreading up to 100° from the rachises, the branches scaberulous, not floriferous near base; secondary branches composed of loosely overlapping spikelets; pulvini ciliate, the hairs up to 7 mm long; pedicels 1.4–5(–7) mm long, erect, wiry, spreading. Spikelets 2–4.5(–5) × 0.5–1.1 mm, 2–7-flowered, narrow lanceolate, light plumbeous to reddish-purple; disarticulation acropetal, paleas and rachilla persistent; glumes 0.6–1.4 mm long, subequal, broadly ovate to narrowly lanceolate, hyaline, keeled, scaberulous along the keel, sometimes reddish-purple; lower glume 0.6–1 mm long; upper glume 1.1–1.4 mm long, usually broader than the lower; lemmas 1.2–1.8 mm long, broadly ovate, membranous, the distal margins hyaline, lateral nerves obscure to barely evident, keeled, scaberulous along the keel near apex; apex acute; paleas 1.1–1.7 mm long, membranous to partially hyaline, scaberulous along keels; apex obtuse; stamens 3, anthers 0.2–0.7 mm long, reddish-purple. Caryopses 0.5–0.6 mm long, obovoid to somewhat prism-shaped, terete to somewhat laterally flattened, with a weak ventral groove, striate and reticulate, usually opaque, irregularly obovate to triangular in cross-section, faintly reddish-brown to whitish. 2*n* = 40, 80 (Gould 1958).

Distribution and habitat.—Native to the Americas with a broad distribution from U.S.A., Mexico, Central America, Argentina, Bolivia, Brazil, Colombia, Ecuador, Peru, Uruguay, and Venezuela (Nicora 1998; Peterson & Boechat 2001); sandy dunes, river banks, near cultivated fields, and open slopes; 0–2800 m.

Specimens examined. **COLOMBIA. Boyacá:** along Río Soapaga, 12 km of Belén, 2460 m, 7 Nov 1944, *F.R. Fosberg 22190* (US). **Cauca:** Chisquio, finca Los Derrumbos, 1700 m, 3 Feb 1940, *E. Asplund 10510* (US). El Ramal to Río Sucio, W of Popayán, 1600–1900 m, 3 Jul 1922, *F.W. Pennell & E.P. Killip 8135* (US). **Cundinamarca:** Sabana de Bogotá, entre Sibaté y San Miguel, 2750 m, 15 Aug 1939, *J. Cuatrecasas 6631* (COL, US). **Huila:** Cordillera Oriental, E of Neiva, 1500 m, 1–8 Aug 1917, *H.H. Rusby & F.W. Pennell 1023* (US). **Valle del Cauca:** Mozambique, N of La Cumbre, 16 Sep 1922, *E.P. Killip 11277* (US). Carretera al mar, W of Cali, Cordillera Occiedental, 1300 m, 13 Nov 1948, *E.P. Killip & F.C. Lehmann 39795* (US). Pavas, Cordillera Occidental, 1500–1800 m, 12 May 1922, *F.W. Pennell 5529* (US). **Unknown department:** *J.C. Mutis 5399* (US), *5401* (US).

11. Eragrostis lurida J. Presl, Reliq. Haenk. 1(4–5):276. 1830. subsp. **lurida (Fig. 7, A–J)**. *Poa lurida* (J. Presl) Kunth, Enum. Pl. 1:342. 1833. Type: PERU: *T. Haenke s.n.* (holotype: PR; isotypes: MO-2111146!, PR, US-2941523 fragm. ex PR!).

Eragrostis contristata Nees & Meyen, Gramineae 31–32. 1841. Type: PERU: Laguna de Titicaca, Apr. 1831, *Meyen s.n.* (holotype: B; isotypes: BAA-1021 fragm. ex B!, LE- TRIN-2326.01!, P!, US-2891461 fragm!).

Eragrostis bahiensis var. *boliviensis* Henrard, Meded. Rijks-Herb. 40:68. 1921. Type: BOLIVIA: La Paz: Larecaja, Sorata, 2900 m, Feb 1858, *G. Mandon 1332* (holotype: L 908,88-303; isotypes: K!, L 908,88-342, P!, US-3161127!, US-256470!, US-911775 fragm. ex L!).

Caespitose perennials with innovations at base; culms (5–)15–75 cm tall, erect, sometimes slightly geniculate below, glabrous or occasionally with a tuft of hairs below the nodes, the hairs less than 1 mm long, sometimes with an occasional elliptical orange gland. Leaf sheaths ¾ to about as long as the internodes above, densely white ciliate at the summit and along the margins, sometimes with scattered hairs on the abaxial surface; ligules 0.5–0.9 mm long, ciliate; blades 1.5–16.5 cm × 1.5–3.5(–5) mm, flat to involute, glabrous and sometimes shinny below and scaberulous above. Panicles 3–35 × 2–5(–7) cm, narrowly ovate, contracted and condensed into tightly glomerate lobes, interrupted near base, spicate to narrowly ovate, rachis glabrous, the ascending primary branches 0.6–5 cm long, densely-flowered, spreading 20–80° from the rachises, floriferous near base; secondary branches condensed into tightly glomerate lobes of spikelets; pulvini ciliate or glabrous; pedicels 0.1–1 mm long, ascending and appressed, wiry, scabrous. Spikelets 2.5–6 × 1–2.1 mm, 3–10-flowered, narrowly lanceolate to ovate, inflated to slightly compressed, dark to light plumbeous, sometimes purple-tinged, rachilla often ciliate; disarticulation acropetal with glumes first, then lemmas falling individually, paleas persistent on rachilla; glumes 1–2 mm long, subequal, broadly ovate to lanceolate, membranous, margins hyaline, keeled, scaberulous along keel, sometimes 3-nerved; lower glumes 1–1.5 mm long; upper glumes 1.2–2 mm long; lemmas 1.6–2.4 mm long, broadly ovate, membranous, lateral nerves conspicuous, evident, keeled; apex acute, scaberulous, the minute prickle hairs appearing as whitish dots under 10–20X; paleas 1.5–2.3 mm long, membranous to partially hyaline, scaberulous along the keels; apex truncate to obtuse; stamens 3, anthers 0.4–0.6 mm long, reddish-purple. Caryopses 0.6–0.8 mm long, obovoid to ellipsoid, striate and reticulate, sometimes with a weak ventral groove, rectangular with the lateral sides angled in cross-section, light reddish-brown. $2n$ = unknown.

Distribution and habitat.—Native to the central Andes from Bolivia, Colombia, Ecuador, and Peru (Nicora 1998; Laegaard & Peterson 2001); dry rocky hillsides, slopes, sandy roadsides, and rocky alluvial fans; 2000–3800 m.

Specimens examined. **COLOMBIA. Cauca:** Popayán, no date, *F.C. Lehmann 6997* (US). **Nariño:** Cumbal, *André 3524* (US). **Unknown department:** *J.C. Mutis 5517* (US).

12. Eragrostis maypurensis (Kunth) Steud., Syn. Pl. Glumac. 1:276. 1854. **(Fig. 8, A–E)**. *Poa maypurensis* Kunth, Nov. Gen. Sp. 1: 161, 162. 1815 (1816). *Megastachya maypurensis* (Kunth) Roem. & Schult., Syst. Veg. 2: 588. 1817. Type: VENEZUELA. Amazonas: Río Orinoco, Apr, *F. Humboldt & A. Bonpland s.n.* (holotype: P!; isotypes: COL!, BAA-1053 fragm!, P!, US-2850758 fragm. ex P-BONPL! & fragm. ex B-WILLD!).

Caespitose annuals. Culms 25–45 cm tall, erect to ascending, often decumbent, many branched from the base forming a rosette, mostly with 2–3(–6) nodes. Leaf sheaths ½–2/3 as long as the internodes above, mostly glabrous, pilose at the summit and along upper margins; ligules ca. 0.5 mm long, ciliate; blades 6–12 cm × 2–4 mm, flat to loosely involute tow. the apex, scattered pilose near base and long margins to pilose abaxially and adaxially, the hairs 1.5–5 mm long, papillose-based. Panicles 6–14 × (1.5–)3–7.5 cm, open, narrowly ovate to oblong, more or less densely-flowered, primary branches 1.5–5 cm long, spreading, solitary at a node, floriferous to base, branches diverging 0–70° from the rachises; pulvini pilose, the hairs up to 4 mm long; pedicels 0–1.5 mm long, shorter than the spikelets, appressed, with a few scattered hairs. Spikelets 8–15(–30) × 1.8–2.5(–3) mm, 12–35-flowered, narrowly lanceolate to ovate lanceolate, florets imbricate often appearing to be borne in fascicles, reddish-purple to yellowish; disarticulation acropetal with the paleas and glumes persistent; glumes (1.5–)2–2.6 mm long, subequal, lanceolate-acuminate, strongly to weakly keeled, scaberulous along the keel; lower glumes 2–2.6 mm long, usually longer than the upper; upper glumes (1.5–)2–2.6 mm long; lemmas 1.8–3 mm long, ovate-acuminate, chartaceous, lateral nerves

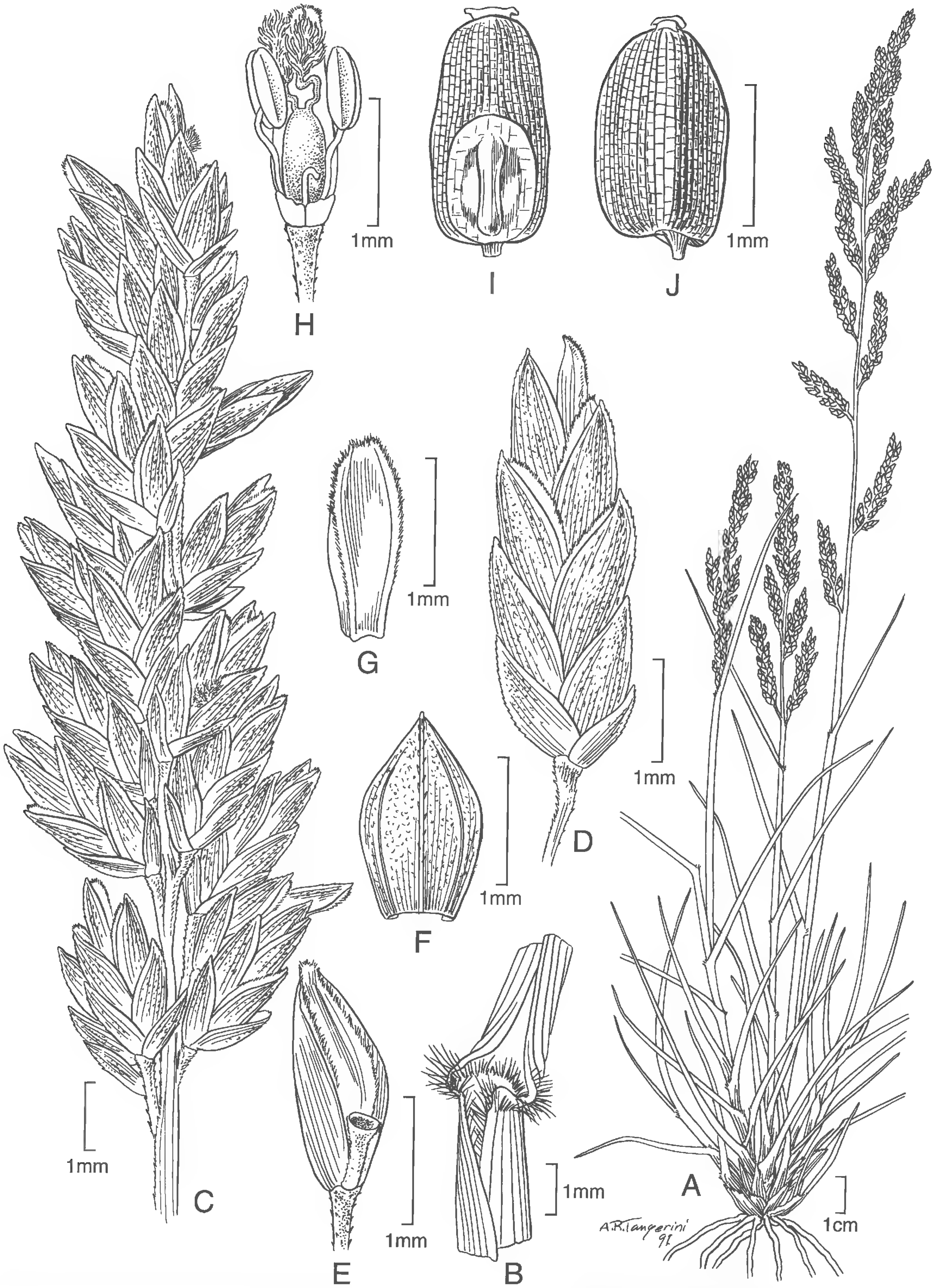
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Fig. 7. *Eragrostis lurida* (*P.M. Peterson, E.J. Judziewicz & R.M. King 9103 & P.M. Peterson & E.J. Judziewicz 9327*, A–H; P.M. *Peterson & N.F. Refulio-Rodriguez 13993*, I & J). **A.** Habit. **B.** Ligule. **C.** Inflorescence. **D.** Spikelet. **E.** Floret. **F.** Lemma, dorsal view. **G.** Palea, dorsal view. **H.** Palea enclosing the stamens, pistil, and lodicules, ventral view. **I.** Caryopsis, dorsal view. **J.** Caryopsis, lateral view.

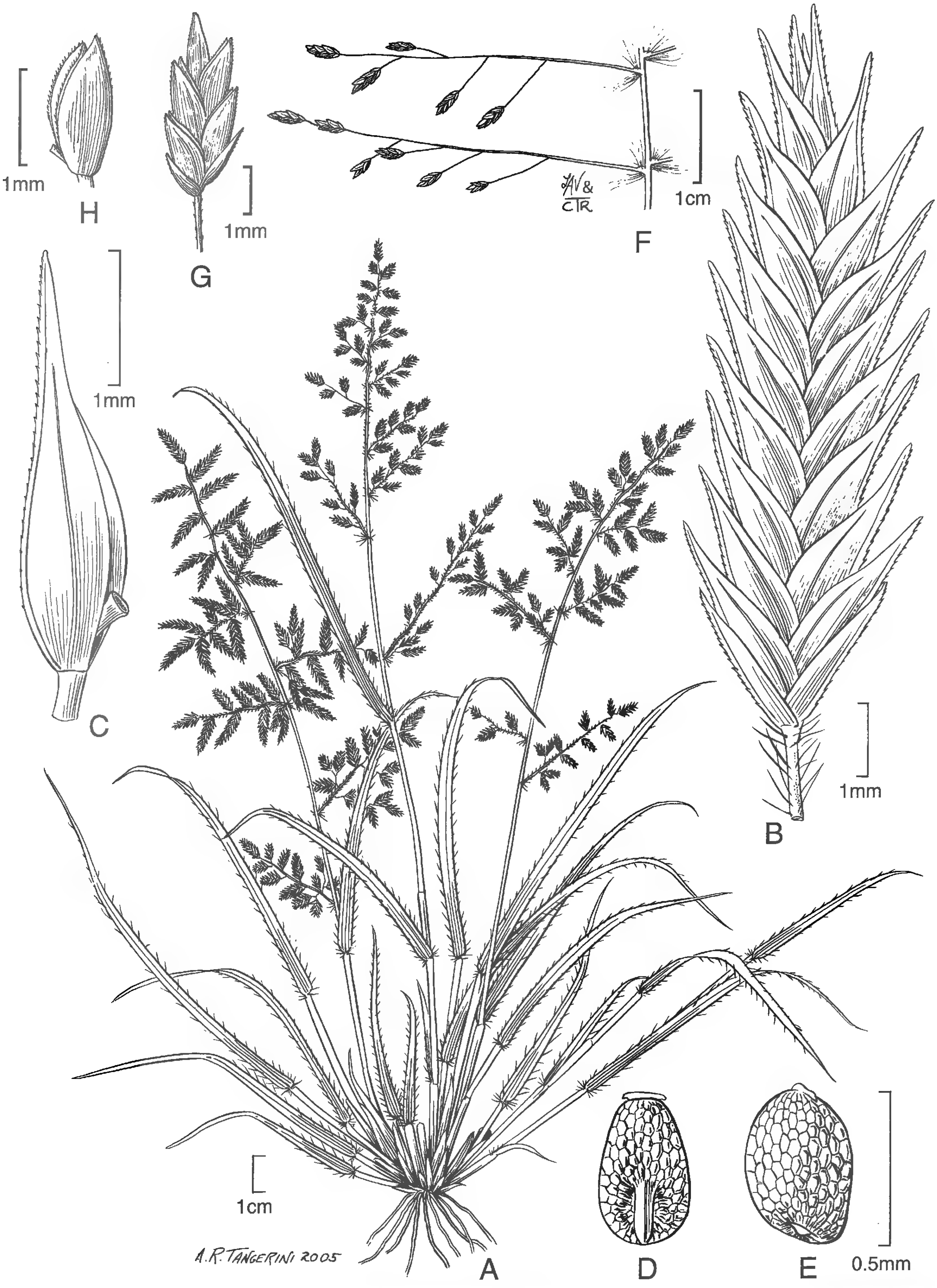
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Fig. 8. *Eragrostis maypurensis* (*J.R. Swallen 3306*, A–C; *C.M. Belshaw 3359*, D & E). A. Habit. B. Spikelet. C. Floret. D. Caryopsis, dorsal view. E. Caryopsis, lateral view. *Eragrostis polytricha*. F. Inflorescence. G. Spikelet. H. Floret.

and midnerve evident usually green; apex acuminate and recurved; paleas 1.5–2.2 mm long, shorter than the lemma, hyaline; stamens 2, anthers 0.2–0.3 mm long, purplish. Caryopses 0.4–0.7 mm long, ovoid, translucent, rhomboid reticulate without striations, obovate to circular in cross-section, reddish-brown. $2n = 20$ (Pohl & Davidse 1971).

Distribution and habitat.—Native to the Americas from México, Central America to South America in Bolivia, Brazil, Colombia, Peru, and Venezuela (Nicora 1998; Laegaard & Peterson 2001); a fairly common grass in the Amazonian region where it is found growing in savannas, sandy sites, along roadsides, and disturbed areas; 100–1500 m.

Vernacular name.—"Colchón de pobre" (Casanare, *J.M. Idrobo 5100*).

Specimens examined. **COLOMBIA. Amazonas:** Araracuara, camino entre el Hospital y el Aeropuerto, ca. 200 m, 12 Sep 1977, *L.E. Aguirre-Galvis 1061* (COL); Río Caquetá, cerca del aeropuerto, 200–250 m, 18 Jul 1977, *A. Fernández-Pérez 20061* (COL). **Antioquia:** Bello, 1500 m, 29 Jun 1930, *W.A. Archer 346* (US). **Casanare:** Esmeralda, 130 m, 19–20 Oct 1938, *J. Cuatrecasas 3863* (COL, US); Mun. El Yopal, sabanas alteradas no inundables, entre el nuevo hospital y la Brigada del Ejército Nacional, 400 m, 3 Nov 2007, *D. Giraldo-Cañas 4149, 4150, 4153* (COAH, COL); El Yopal, hato Mate Pantano, 10 Oct 1962, *J.M. Idrobo 5100* (COL); Mun. Paz de Ariporo, corregimiento La Hermosa, finca Nicaragua, caño Pica Pico, 112 m, 25 Oct 2004, *J.G. Ramírez 8705* (COAH, COL); Tauramena, quebrada Tauramena, 550 m, 30 Nov 1960, *L. Uribe Uribe 3588* (COL). **Cauca:** along Río Palo at El Palo, 15 Dec 1943, *E.L. Core 171* (US); Río Patía, 11 May 1935, *H. García-Barriga 4497* (COL, US). **Guainía:** Bassin de L'Amazone, Río Negro a San Felipe, 200 m, 13–25 Nov 1952, *H. Humbert 27487* (US); Puerto Colombia, opposite Venezuelan town of Maroa, and vicinity, ca. 280 m, 31 Oct 1952, *R.E. Schultes 17927* (COL, US). **Guaviare:** Mun. San José del Guaviare, trocha Nuevo Tolima, 11 Nov 1996, *R. López & O. Rodríguez 1859* (COAH, COL). **Huila:** Five km N of Villavieja, upper basin of Río Magdalena, 400 m, 23 Jul 1950, *S.G. Smith 1256* (COL, US). **Magdalena:** Cerca de Gamarra (Santander), valle del río Magdalena, 100 m, 23 Dec 1948, *J. Araque-Molina & F.A. Barkley 18-Mg-072* (US); Santa Marta, 1898–1901, *H.H. Smith 132* (COL, MO, US). **Meta:** Mun. Villavicencio, carretera Villavicencio-Aeropuerto, piedemonte de la cordillera Oriental, sitio La Arenera, ca. 2 km del puente sobre el río Guatiquía, ca. 400 m, 14–15 Dec 2002, *D. Giraldo-Cañas 3384* (COAH, COL, HUA); Río Meta, Cabuyaro, 235 m, 14 Oct 1938, *J. Cuatrecasas 3612* (COL, US); Río Meta, La Ochovera, 28 Oct 1938, *J. Cuatrecasas 4182* (COL, US); Villavicencio, Apiai, 500 m, 12 Nov 1938, *J. Cuatrecasas 4730* (COL, US); Llanos Orientales, Puerto López, al SE de Cabuyaro, alrededores de la laguna de Yurimena, 175–200 m, 16 Sep 1958, *R. Jaramillo-Mejía 1247* (COL, US); Carimagua, 200 m, 18 Sep 1992, *S. A. Renvoize 5399* (COL, US); San Juan de Arama, caño Curía, 440 m, 31 Dec 1986, *D. Rivera 1265* (COL); Loma Linda, al sureste de San Martín, 300 m, 15 Sep 1966, *A. Robinson 3079* (US); Villavicencio, 450 m, Jan 1856, *J.J. Triana 70* (US), *297* (US). **Nariño:** Carretera Pasto-Túquerres, alrededores del río Juanambú, 1380 m, 1–5 Dec 1962, *C. Saravia 1950* (COL). **Santander:** "Kilómetro 16," between Puerto Wilches and Puerto Santos, 110–115 m, 29 Nov 1926, *E.P. Killip & A.C. Smith 14825* (MO, US); Carretera Puerto Wilches-Sabana de Torres, km 46, 250 m, 16 Nov 1985, *J.H. Torres 2816, 2817* (COL). **Tolima:** no data, *André 1924* (US); Melgar, 500–600 m, 4–5 Dec 1917, *F.W. Pennell 2903* (US). **Valle del Cauca:** Around Cali, western side of Cauca Valley, 1000–1200 m, Dec 1905, *H. Pittier 639* (US), *660* (US). **Vichada:** Región Guayanesa, Mun. Puerto Carreño, afloramientos rocosos del tipo lajas, entre Punta de Lajas y Cerro El Bita, ribera del río Orinoco, 40–100 m, 4–5 Jan 2004, *D. Giraldo-Cañas & C. Parra 3648, 3655* (COAH, COL); Río Orinoco, Puerto Carreño, 23–24 Oct 1938, *J. Cuatrecasas 4072* (COL, US); ca. 10 km W of Las Gaviotas along road to Puerto Gaitán, 180 m, 30 Dec 1973, *G. Davidse & F. Llanos 5367-A* (COL, MO, US); Gualandayas, ca. 100 km E of Gaviotas, 100 m, 31 Dec 1983, *J.R.I. Wood 4213* (COL). **Unknown department:** *F.C. Lehmann 778* (US), *I. Linden 1554* (US), *Moritz s.n.* (US), *J.C. Mutis 6094* (US), *J.J. Triana 298* (US).

13. Eragrostis mexicana (Hornem.) Link, Hort. Berol. 1:190. 1827. (**Fig. 9**). *Poa mexicana* Hornem., Hort. Bot. Hafn. 2:953. 1815. TYPE: MÉXICO: cultivated from seed collected in México, *Sessé s.n.* (LECTOTYPE: MA! designated by Peterson & Sánchez Vega, Ann. Missouri Bot. Gard. 94:773. 2007).

Caespitose annuals. Culms 10–130 cm tall, erect, sometimes geniculate, glabrous, sometimes with a ring of glandular depressions below the nodes. Leaf sheaths ½–2/3 as long as the internodes, sometimes with glandular pits, pilose near the apices and on the collars, hairs to 4 mm long, papillose-based; ligules 0.2–0.5 mm long, ciliate; blades 5–25 cm × 2–7(–9) mm, flat, abaxial surfaces glabrous, adaxial surfaces scabridulous, occasionally pubescent near the base. Panicles (5–)10–40 × (2–)4–18 cm, less than ½ the height of the plant, ovate, rachises angled and channeled; primary branches 3–12(–15) cm long, solitary to whorled, appressed or diverging to 80° from the rachises; secondary branches somewhat appressed; pulvini glabrous; pedicels 1–6(–7) mm long, almost appressed to narrowly divergent, stiff. Spikelets (4–)5–10(–11) × 0.7–2.4 mm, 5–11(–15)-flowered, linear to linear-lanceolate or ovate to oblong, gray-green to purplish; disarticulation acropetal; glumes 0.7–2.3 mm long, subequal, ovate to lanceolate, membranous; lemmas 1.2–2.4 mm long, ovate, membranous, glabrous or with a few hairs, gray-green, lateral veins evident, often greenish; apex acute; paleas 1–2.2 mm long, hyaline, keels scabrous; apex obtuse to truncate; stamens 3; anthers 0.2–0.5

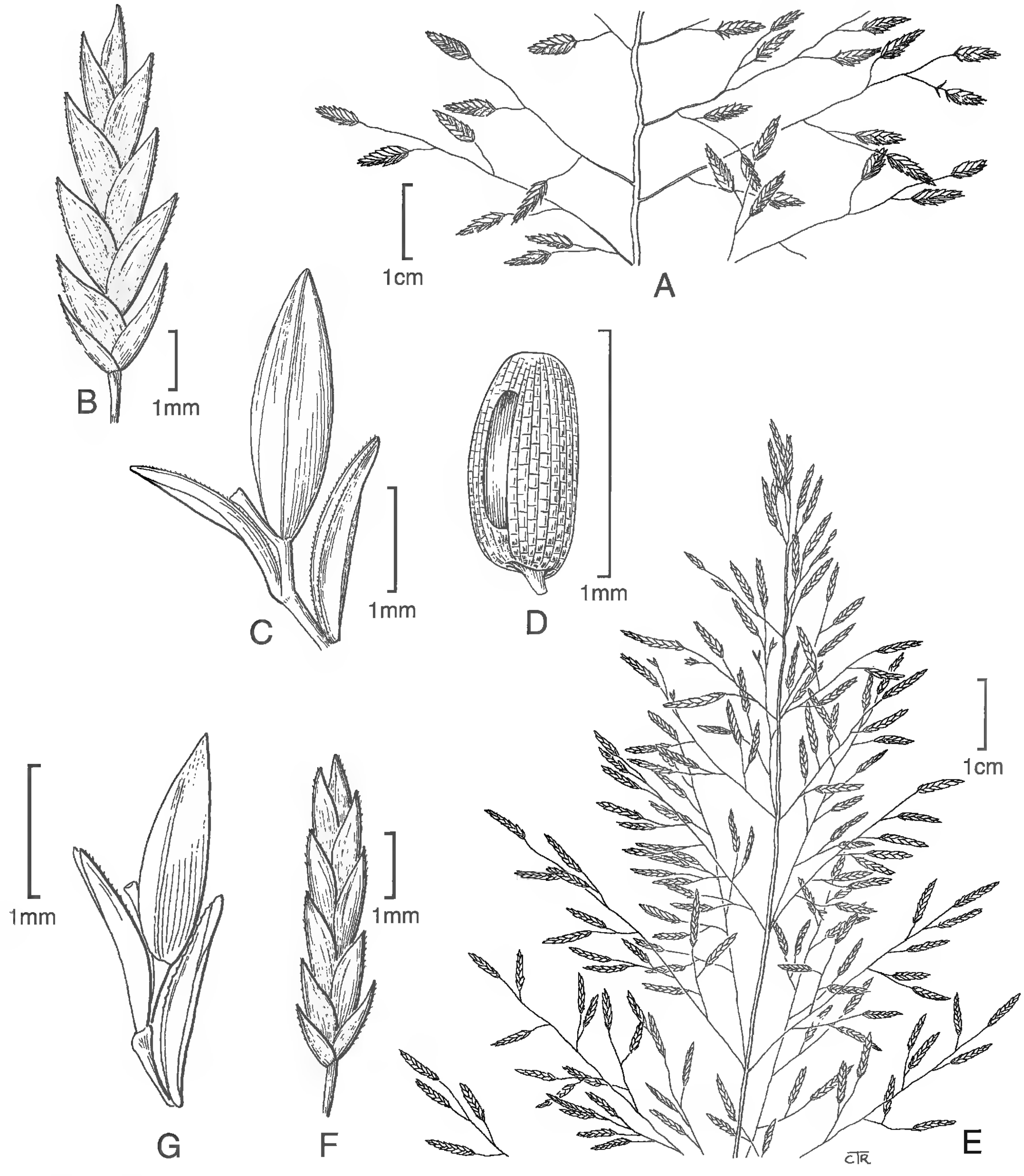

Fig. 9. ***Eragrostis mexicana*** **var.** ***mexicana*** **(*I. Sánchez-Vega 4020,* D). A. Inflorescence. B. Spikelet. C. Floret with two paleas attached below. D. Caryopsis, lateral view. *Eragrostis mexicana* var. *virescens*. E. Inflorescence. F. Spikelet. G. Floret with two paleas attached below.**

mm long, purplish. Caryopses 0.5–0.8(–1) mm long, ovoid to rectangular-prismatic, laterally flattened, shallowly to deeply grooved on the ventral surface, striate and reticulate, irregularly triangular in cross-section, reddish-brown, distal 2/3 opaque. $2n = 60$ (Pohl & Davidse 1971).

Distribution and habitat.—*Eragrostis mexicana* is native to the Americas and grows along roadsides, near cultivated fields, city sidewalks, and in disturbed open areas, in lomas vegetation and slopes of the inter-Andes of Colombia; 1000–2400 m. The species has been treated as two distinct subspecies by Koch and Sánchez Vega (1985) and Peterson and Sánchez Vega (2007), both of which occur in Colombia.

KEY TO THE SUBSPECIES OF *ERAGROSTIS MEXICANA*

1. Spikelets ovate to oblong in outline, 1.5–2.4 mm wide; lower glumes 1.2–2.3 mm long; sum of the spikelet width and lower glume length 2.7–4.7 mm; culms and sheaths sometimes with glandular depressions __________ **13a. E. mexicana** subsp. **mexicana**

1. Spikelets linear to linear-lanceolate, 0.7–1.4 wide; lower glumes 0.7–1.7 mm long; sum of the spikelet width and lower glume length 1.5–3.1 mm; culms and sheaths without glandular depressions __________ **13b. E. mexicana** subsp. **virescens**

13a. Eragrostis mexicana (Hornem.) Link subsp. **mexicana** (**Fig. 9, A–D**).

Eragrostis limbata E. Fourn., Mexic. Pl. 2:116. 1886. Type: MÉXICO: 1833, *A.J.A. Bonpland 4573* (lectotype: P! designated by R. McVaugh, Fl. Novo-Galic. 14:168. 1983 but specific herbarium not indicated, Bonplands collections are housed at P; isotype: US-2941517 fragm!).

Eragrostis neomexicana Vasey ex L.H. Dewey, Contr. U.S. Natl. Herb. 2(3):542. 1894. Type: U.S.A. New Mexico: Organ Mountains, 1881, *G. Vasey 474* (lectotype: US-176631! designated by S.D. Koch and I. Sánchez Vega, Phytologia 58:379. 1985; isotypes: K!, US-822049!, US-909912!).

Eragrostis alba J. Presl, Reliq. Haenk. 1(4–5):279. 1830. *Poa alba* (J. Presl) Kunth, Enum. Pl. 1:343. 1833. Type: PERÚ: *T. Haenke s.n.* (holotype: PR; isotypes: MO-2111118!, US-2942409 fragm. ex P!).

Culms and sheaths sometimes with glandular depressions. Spikelets 1.5–2.4 mm wide, ovate to oblong; lower glumes 1.2–2.3 mm long; sum of spikelet width and lower glume length 2.7–4.7 mm.

Specimens examined. **COLOMBIA. Boyacá:** Mun. Ráquira, cerca de los hornos de los artesanos, en inmedfiaciones del camino que conduce al desierto de La Candelaria, 2300 m, 19 Jul 2003, *D. Giraldo-Cañas 3555, 3555-B* (COL); Mun. Villa de Leyva, saliendo por el camino que conduce a Iguaque, en las afueras del casco urbano de Villa de Leyva, 2200 m, 18 Dec 2004, *D. Giraldo-Cañas 3825, 3835, 3836* (COL); between Boavita and the Río Chicamocha, 1500 m, 25 Jun 1984, *J.R.I. Wood 4468* (COL). **Cauca:** Popayán, 1600–1800 m, Feb 1887, *F.C. Lehmann 4401* (US). **Cundinamarca:** Mun. Choachí, carretera Choachí-Termales de Choachí, km 2, 1600 m, 12 Nov 2001, *D. Giraldo-Cañas 3284* (COL). **Nariño:** Carretera Pasto-Túquerres, alrededores del río Juanambú, 1380 m, 1–5 Dec 1962, *C. Saravia 1954* (COL). **Santander:** 2 km al sur de Suratá, 1900 m, 4 Aug 1966, *A. Robinson 3054* (US). **Valle del Cauca:** between Uribe and Sevilla, 1100 m, 2 Mar 1983, *J.R.I. Wood 4082* (COL).

13b. Eragrostis mexicana subsp. **virescens** (J. Presl) S.D. Koch & Sánchez Vega, Phytologia 58(6):380. 1985. (**Fig. 9, E–G**). *Eragrostis virescens* J. Presl, Reliq. Haenk. 1(4–5):276. 1830. *Poa virescens* (J. Presl) Kunth, Enum. Pl. 1:329. 1833. Type: CHILE: *T. Haenke s.n.* (holotype: PR; isotypes: B!, BAA-1107 fragm. ex B!, LE-TRIN-2413.01!, US-2942410 fragm!).

Eragrostis leptantha Trin., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 1(4):405. 1830. *Poa leptantha* (Trin.) Kunth, Enum. Pl. 1:339. 1833. Type: BRAZIL: in siccis arenosesum pr. Moji [Sao Paulo], 23 Apr, [*Riedel s.n.*] *G.H. von Langsdorff s.n.* (holotype: LE-TRIN-2361.01!; isotypes: BAA-1043 fragm.!, K, LE, MO-2111141!, NY!, P!, US-2941514 fragm.!).

Eragrostis delicatula Trin., Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 2(1):73. 1836. *Eragrostis pilosa* var. *delicatula* (Trin.) Hack., Anales Mus. Nac. Buenos Aires 11:133. 1904. Type: BRAZIL: In cultis prope Rio de Janeiro, May–Jun 1823, *L. Riedel s.n.* (holotype: LE-TRIN-2330.01!; isolectotypes: LE, US-2891464 fragm.!).

Eragrostis rahmeri Phil., Verz. Antofagasta Pfl. 88. 1891. Type: CHILE. Tarapacá: Quebrada de Guaviña, 13 Mar 1885, *R.A. Philippi 359* (holotype: SGO-PHI-359; BAA-1080 fragm.!, CORD!, SGO-37293; SGO-63537, SGO-62670, US-556538 fragm. ex SGO-PHIL-359!).

Eragrostis cordobensis Jedwabn., Bot. Arch. 5(3–4):208. 1924. Type: ARGENTINA. Córdoba: prope urbem, 21 Apr 1881, *Galander 54b* (lectotype: BAA! designated by Boechat & Longhi-Wagner, Iheringia, Bot. 55:164. 2001; isolectotype: US-2767407!).

Culms and sheaths without glandular depressions. Spikelets 0.7–1.4 mm wide, linear to linear-lanceolate; lower glumes 0.7–1.7 mm long; sum of spikelet width and lower glume length 1.5–3.1 mm.

Distribution and habitat.—This subspecies is native to South America in Argentina, Bolivia, Brasil, Chile, Colombia, Paraquay, Peru, and Uruguay; introduced in Canada, México, and U.S.A. (Nicora 1998; Peterson & Boechat 2001; Peterson & Sánchez Vega 2007).

Specimens examined. **COLOMBIA. Antioquia:** Mun. Sabaneta, parque central de la municipalidad, 1550 m, 3 Jan 2003, *D. Giraldo-Cañas 3428* (COL, HUA). **Cauca:** Mun. Popayán, sector norte de la ciudad, Villa del Viento, 1800 m, 7 Jan 2001, *B.R. Ramírez 13911* (CAUP, COL). **Quindío:** Mun. Calarcá, entrada del jardín botánico del Quindío, 1500 m, 20–25 May 2005, *D. Giraldo-Cañas 3893* (COL, HUA). **Santander:** Entre el cañón del Chicamocha y el valle de Rupala, 1000 m, 14. Jun 1962, *C. Saravia 772* (COL). **Tolima:** Cordillera Central andina, Mun. Ibagué, jardineras y andenes de la Plaza de Bolívar, 1200 m, 11–12 Jun 2005, *D. Giraldo-Cañas 3903* (CAUP, COL, HUA).

14. Eragrostis mokensis Pilg., Bot. Jahrb. Syst. 51(3–4):419. 1914. **(Fig. 10, A–D)**. TYPE: EQUATORIAL GUINEA. FERNANDO PO: Grasland (Bergweiden) von Moka im Südosten der Insel, 1200–1800 m, Nov 1911, *J. Mildbraed 7102* (HOLOTYPE: B; ISOTYPE: US-2941533!).

Eragrostis moritzii Jedwabn., Bot. Arch. 4:328. 1923. TYPE: VENEZUELA. MERIDA: in der Alpinen Region, *J.W.K. Moritz 1570* (ISOTYPE: US-2941535 fragm.!).

Caespitose annuals. Culms 10–30(–45) cm tall, erect or ascending, sometimes geniculate, branched at the base and lower nodes, often with a small glandular ring below the glabrous nodes. Leaf sheaths overlapping below to ½ the length of the internodes above, sparsely pilose at the summit and along margins below, the hairs up to 3 mm long and papillose-based; ligules 0.1–0.3 mm long; blades 3–8(–10) cm long, 2–4 mm wide, flat, sparsely pilose with papillose-based hairs. Panicles 4–13 cm long, 2.5–7(–10) cm wide, narrowly, ovate, open, the rachis angled; primary branches 2–7 cm long, ascending, stiff, spreading up to 90° from the rachises; secondary branches widely spreading; pulvini glabrous, smooth; pedicels 0.5–2.5 mm long, shorter than the spikelets. Spikelets 3–6.5(–7) mm long, 2–2.5 (–3) mm wide, (4–)10–20-flowered, broadly ovate-lanceolate, the florets strongly imbricate, plumbeous to reddish-purple; disarticulation acropetal, with the glumes first, then the lemmas and paleas falling as a unit; glumes 1–1.5 mm long, subequal, ovate, membranous, keeled, scaberulous along the keel, apex acute; lemmas 1.2–1.6 mm long, 0.6–1.1 mm wide, orbicular, chartaceous, lateral nerves absent or obscure, apex keeled and obtuse; paleas 1.1–1.4 mm long, 0.6–0.8 mm wide, orbicular, deciduous, winged, scaberulous, apex truncate; stamens 3; anthers 0.3–0.5 mm long, purplish. Caryopses 0.6–0.7 mm long, ovoid, striate and reticulate, flattened on the adaxial surface, reddish-brown. $2n$ = unknown.

Distribution and habitat.—Native to western Africa (Clayton 1972), *E. mokensis* has been reported from Brazil and Venezuela (Boechat & Longhi-Wagner 2001). Herein, we report it for the first time in Colombia. This species occurs in rocky areas, along roadsides, and near cultivated fields and in waste areas often associated with *Melinus multiflora* P. Beauv. and other ruderal plants; 1700–2000 m.

Comments.—*Eragrostis mokensis* is very similar in habit, panicle characteristics, and overall spikelet shape and color to *E. unioloides* (Retz.) Nees ex Steud. However, *E. mokensis* can be separated from the latter by having orbicular lemmas with obtuse apices (verses ovate lemmas with acute apices in *E. unioloides*), shorter pedicels (0.5–2.5 mm long versus 2–10 mm long in *E. unioloides*), somewhat narrower spikelets [2–2.5(–3) mm wide verses 2–3.4 mm wide], and florets with three stamens (two stamens reported in *E. unioloides*) [Clayton 1972].

Specimen examined. **COLOMBIA. Cauca:** Highlands of Popayán, 1700–2000 m, 1889, *F.C. Lehmann BT-635* (US).

15. Eragrostis nigricans (Kunth) Steud., Nom. Bot. ed. 2, 1:563. 1840. **(Fig. 6, E–H)**. *Poa nigricans* Kunth, Nov. Gen. Sp. 1:159. 1816. *Megastachya nigricans* (Kunth) Roem. & Schult., Syst. Veg. 2:586. 1817. TYPE: ECUADOR: Chillo & Sangolqui, Apr–May, *F. Humboldt & A. Bonpland 2291* (HOLOTYPE: P-Bonpl!; ISOTYPES: BAA-1062 fragm.!, K photo!, LE-TRIN-2371.01!, P!, US-2891495 fragm. ex LE-TRIN! &!, fragm. ex P!).

Eragrostis scabra Phil., Fl. Atacam. 55. 1860. TYPE: CHILE. ATACAMA: prope Paposo, Dec 1851, *R.A. Philippi 1051* (HOLOTYPE: SGO-PHIL 357; ISOTYPES: B!, BAA-1089 fragm. ex B!, US 556539 fragm. ex SGO-PHIL 357! & photo!).

Eragrostis rahmeri Phil., Verz. Antofagasta Pfl. 88. 1891. TYPE: CHILE. TARAPACÁ: Quebrada de Guaviña, 13 Mar 1885, *R.A. Philippi s.n. 359* (HOLOTYPE: SGO-PHIL 359; ISOTYPES: BAA-1080 fragm!, CORD!, SGO-37293, SGO-63537, SGO-62670, US-556538 fragm. ex SGO-PHIL 359!).

Eragrostis tristis Jedwabn., Bot. Arch. 5(3–4):205. 1924. *Eragrostis nigricans* var. *tristis* (Jedwabn.) Pilg., Notizbl. Bot. Gart. Berlin-Dahlem 11:778. 1933. TYPE: BOLIVIA: ad Huancapamba, 15 Feb 1910, *Pflanz 359* (LECTOTYPE: BAA-1101 fragm. ex B!, designated by Peterson & Sánchez Vega, Ann. Missouri Bot. Gard. 94:775. 2007).

Eragrostis subatra Jedwabn., Bot. Arch. 5(3–4):202. 1924. TYPE: BOLIVIA: Prope La Paz, 1889, *M. Bang 80* [collector erroneously cited as Rusby in protologue] (HOLOTYPE: B; ISOTYPES: K!, US-822065!).

Caespitose annuals. Culms (10–)20–50(–80) cm tall, erect, sometimes geniculate below, mostly glabrous and somewhat shiny below the nodes. Leaf sheaths 1/3–2/3 as long as the internodes, sparsely pilose at the summit and along the upper margins, the hairs up to 2.5 mm long, sometimes the margins glabrous; ligules 0.4–0.6 mm long, ciliate; blades 6.5–10 cm × 2–5 mm, flat, occasionally loosely involute near apex, glabrous

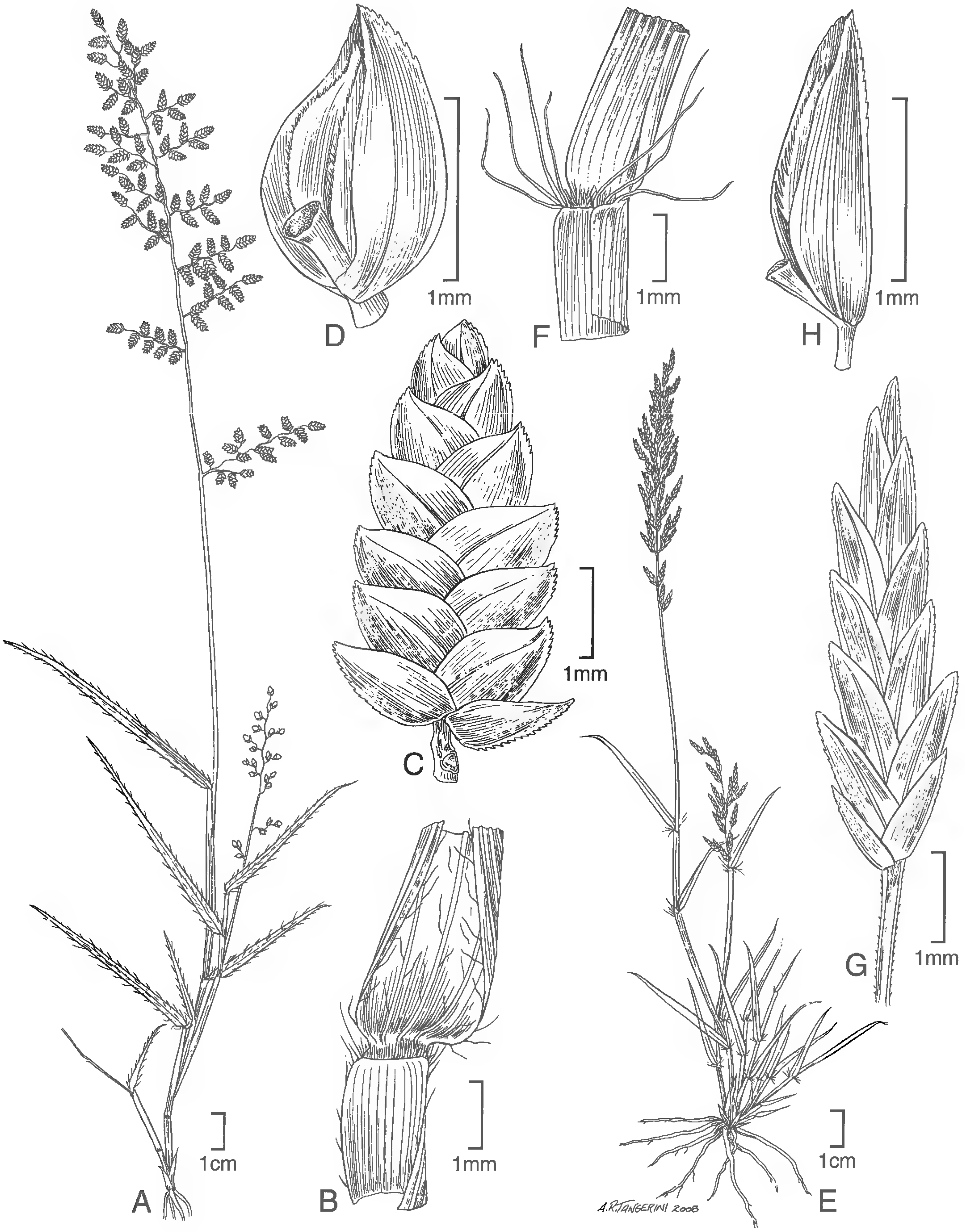
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Fig. 10. *Eragrostis mokensis* (*B.T. Lehmann 635*). A. Habit. B. Ligule. C. Spikelet. D. Floret. *Eragrostis rufescens* (*F.R. Fosberg 22208*). E. Habit. F. Ligule. G. Spikelet. H. Floret.

above and below, somewhat scaberulous near apex. Panicles (5–)7–24 × 2–7(–15) cm, oblong, somewhat condensed, the spikelets arranged in glomerules that are widely spaced along the channeled rachis, primary branches mostly 1–10 cm long, sinuous, ascending and spreading 20–90° from the rachises, solitary to whorled below, scaberulous, secondary branches sinuous; pulvini glabrous to sparsely pilose, the hairs up to 1.5 mm long; pedicels 0.4–2(–3) mm long, stiffly spreading, divaricate and stout, scaberulous. Spikelets 2.6–3.8(–4.8) × 1–1.2 mm, 2 mm, 2–4(–5)-flowered, linear to narrowly lanceolate, grayish-green to purplish-green; disarticulation acropetal, with the glumes first, then the lemmas falling, paleas persistent; glumes 1.0–1.4 mm long, subequal, ovate to lanceolate, membranous, keeled, scaberulous along the keel; lemmas 1.6–2.0 mm long, ovate, membranous; grayish-green, glabrous or with a few scattered hairs, lateral nerves sometimes distinct; apex acute, sometimes scaberulous; paleas 0.9–1.4 mm long, hyaline, scaberulous along the keels; apex truncate; stamens 3, anthers 0.3–0.5 mm long, purplish. Caryopses (0.6–)0.7–1.1 mm long, ovoid, striate and reticulate, shallowly to deeply grooved on the ventral surface, translucent, irregularly rectangular in cross-section, reddish-brown.

Distribution and habitat.—Native to the Andean mountains in Argentina, Bolivia, Chile, Ecuador, and Peru (Nicora 1998; Peterson & Boechat 2001); occurs on rocky slopes, near cultivated fields, and disturbed roadsides; 1000–4000 m. We report this species for the first time in Colombia.

Specimens examined. **COLOMBIA. Santander:** Minas San Juan, 5 km arriba de California, 2733 m, 4 Aug 1966, *A. Robinson 3032* (US); Carretera Bucaramanga–Cúcuta, 1700 m, 29 Sep 1966, *A. Robinson 3125* (US).

16. Eragrostis pastoensis (Kunth) Trin., Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 4(2):71. 1836. (**Fig. 11, A–J**). *Poa pastoensis* Kunth, Nov. Gen. Sp. 1:160. 1815 (1816). *Megastachya pastoensis* (Kunth) Roem. & Schult., Syst. Veg. 2: 587. 1817. Type: COLOMBIA: Pasto, Mt. Arand, *F. Humboldt & A. Bonpland 2149* (holotype: P-Bonpl!; isotypes: P!, P photo at K!, US-2767397 fragm. ex P-Bonpl.!).

Poa montufari Kunth, Nov. Gen. Sp. 1:159. 1815 (1816). *Eragrostis montufari* (Kunth) Steud., Nom. Bot. (ed. 2) 1:563. 1840. *Megastachya montufari* (Kunth) Roem. & Schult., Syst. Veg. 2:586. 1817. Type: ECUADOR. Pichincha: betw. Puembo & San Antonio de Lulumbamba, Apr–May, *F. Humboldt & A. Bonpland s.n.* (holotype: P-Bonpl.!; isotypes: BAA-1056!, P!, US-2891497! [fragm.] ex P-Bonpl.!).

Poa olmedoi Kunth, Nov. Gen. Sp. 1:159–160. 1815 (1816). *Megastachya olmedoi* (Kunth) Roem. & Schult., Syst. Veg. 2:586. 1817. *Eragrostis olmedoi* (Kunth) Steud., Nom. Bot. (ed. 2) 1:564. 1840. Type: PERU: Jul, *F. Humboldt & A. Bonpland s.n.* (holotype: P!).

Poa tenax Kunth, Nov. Gen. Sp. 1:160. 1815 (1816). *Eragrostis tenax* (Kunth) Steud., Nom. Bot. (ed. 2) 1:564. 1840. *Megastachya tenax* (Kunth) Roem. & Schult., Syst. Veg. 2:587. 1817. Type: ECUADOR: Apr–May, *F. Humboldt & A. Bonpland s.n.* (holotype: P!; isotype: US-2891490 fragm. ex P-Bonpl.!).

Poa setifolia Benth., Pl. Hartw. 262. 1846. *Eragrostis setifolia* (Benth.) Steud., Syn. Pl. Glumac. 1:274. 1854, *nom. illeg. hom.* Type: ECUADOR: Quito, *Hartweg 1452* (holotype: K!; isotypes: US-2826937 fragm. ex K!, US-2850739 fragm. ex CG! & fragm. ex P!, fragm. ex P-STEUD!).

Eragrostis lehmannii Pilg., Bot. Jahrb. Syst. 27(1–2):32. 1899. Type: ECUADOR: Ca. Baños ad flumen Tunguragua, 1800–2500 m, *F.C. Lehmann 5283* [error for *5823*] (isotype: US-2767406 fragm!).

Eragrostis virescens var. *trachyphylla* Hack., Anales Mus. Nac. Buenos Aires 13:505. 1906. Type: ARGENTINA. Tucumán: *Stuckert herb. arg. 14866 ex Lillo Herb. arg. 3192* (holotype: W; isotype: US-2942411 fragm.!).

Eragrostis buchtienii Hack., Repert. Spec. Nov. Regni Veg. 6:157. 1908. Type: BOLIVIA. Süd-Yungas: Simpayas bei Yanacachi, *O. Buchtien 428* (holotype: W; isotype: US-77388!).

Caespitose perennials with innovations. Culms 30–90 cm tall, erect, sometimes geniculate below, glabrous and somewhat shiny below the nodes. Leaf sheaths overlapping below, 3/4 as long as the internodes above, ciliate at the summit and along the upper margins; ligules 0.2–0.5 mm long, ciliate; blades 5–40(–45) cm × 1–4(–7) mm, involute or flat, glabrous to scaberulous below and scaberulous above, sometimes with scattered hairs, the hairs up to 4 mm long. Panicles 8–45 × 1–27 cm, ovate, lanceolate to narrowly oblong, contracted or open, rachis glabrous, the ascending primary branches 1–20 cm long, appressed to widely spreading up to 80° from the rachises, the branches glabrous to scaberulous, not floriferous near base; secondary branches composed of loosely overlapping spikelets; pulvini ciliate or glabrous; pedicels 0.5–5 mm long, erect, mostly appressed, sometimes with hairs. Spikelets 2–6 × 1–1.8 mm, 2–8-flowered, lanceolate to oblong-ovate, inflated to slightly compressed, plumbeous, sometimes purple-tinged, rachilla sometimes sparingly ciliate; disarticulation acropetal, with the glumes first then the lemmas falling individually, paleas persistent; glumes 1–1.9 mm long, subequal, broadly ovate to lanceolate, membranous, sub-hyaline, keeled,

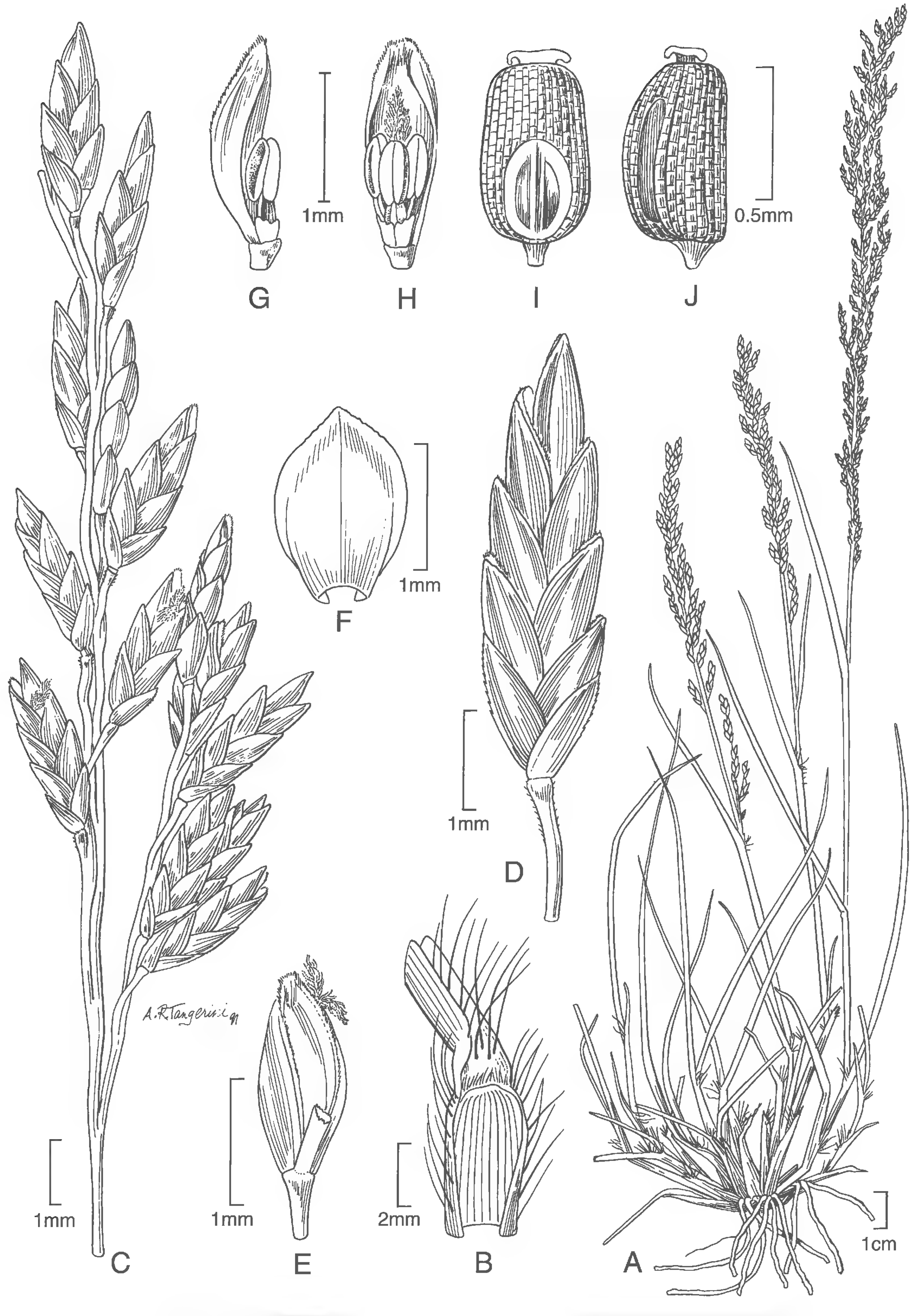
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Fig. 11. *Eragrostis pastoensis* (*P.M. Peterson, C.R. Annable & M.E. Poston 8910 & P.M. Peterson & E.J. Judziewicz 9268*, A–H; P.M. *Peterson & N.F. Refulio-Rodriguez 13982*, I & J). A. Habit. B. Ligule. C. Inflorescence. D. Spikelet. E. Floret. F. Lemma, dorsal view. G. Palea, stamen, and lodicule, lateral view. H. Palea enclosing the stamens, pistil, and lodicules, ventral view. I. Caryopsis, dorsal view. J. Caryopsis, lateral view.

scaberulous along the keel; lower glume 1–1.4 mm long, narrow lanceolate; upper glume 1.2–1.9 mm long, usually broader than the lower; lemmas 1.2–2.0(–2.1) mm long, ovate to broadly ovate, membranous, lateral nerves obscure, keeled, especially towards the apex, scaberulous along the keel; apex acute; paleas 1–2 mm long, membranous to partially hyaline, scaberulous along the keels; apex obtuse to truncate; stamens 3, anthers 0.3–0.6 mm long, reddish-purple. Caryopses 0.4–0.9 mm long, obovoid to prism-shaped, striate and reticulate, usually with a ventral groove, irregularly rectangular in cross-section, light reddish-brown to translucent. $2n = 70$ (Bowden & Senn 1962, as *Eragrostis montufari*).

Distribution and habitat.—Native to South America in Argentina, Bolivia, Brazil, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela (Nicora 1998; Peterson & Boechat 2001); occurs on dry rocky hillsides, slopes, pastures, roadsides, barrancas and city sidewalks from 1400–3600 m.

Specimens examined. **COLOMBIA. Bogotá D.C.:** Bogotá, localidad de Usme, alrededores y riberas del río Tunjuelito, en imediaciones del casco urbano de Usme, 2800 m, 16 Sep 2001, *D. Giraldo-Cañas 3235* (COL); Bogotá, en las grietas del estacionamiento del Instituto de Ciencias Naturales, Campus de la Universidad Nacional de Colombia, 2600 m, 11 Dec 2003, *D. Giraldo-Cañas 3616* (COL). **Boyacá:** Mun. Villa de Leyva, camino entre la hacienda "Torcoroma de Arriba" y el cañón de Las Clusias, 2500 m, 18 Jul 2003, *D. Giraldo-Cañas 3535, 3539* (COL); Mun. Tunja, campus de la Universidad Pedagógica y Tecnológica de Colombia, 2700 m, 12 Nov 2003, *D. Giraldo-Cañas 3608* (COL). **Cundinamarca:** Mun. Nemocón, carretera principal entre la vereda Susatá y Nemocón, 2700 m, 4 Nov 2002, *D. Giraldo-Cañas 3320* (COL); Guasca, 1 Aug 1919, *B. Ariste-Joseph A-368* (US); region of Bogotá, no date, *B. Ariste-Joseph s.n.* (US-1040145); Sabana de Bogotá, entre Sibaté y San Miguel, 2750 m, 15 Aug 1939, *J. Cuatrecasas 6640* (COL, US); Salto del Tequendama, 2500 m, 8 Mar 1939, *E.P. Killip 34006* (US), *34016* (US); Hoya del río Checua Loma, 250 m SE de San José, arenas del Cacho, 2640 m, 8 Dec 1966, *Schrimpff 117* (COL); Andes de Bogotá, 2700 m, Oct 1856, *J.J. Triana s.n.* (US-1865282). **Nariño:** Mun. Sapuyes, El Espino, 3200 m, 15 May 1964, *L.E. Mora 2984-B* (COL, PSO); Mun. Piedrancha, arriba de El Guabo, 2300 m, 15 May 1964, *L.E. Mora 3005* (COL, PSO); Mun. Pasto, corregimiento Chachagüí, 2000 m, 1 Jun 1989, *B.R. Ramírez 1579* (COL, PSO). **Norte de Santander:** Pamplona, 23 Mar 1935, *W.A. Archer 3232* (US); highway between Pamplona and Málaga, 24 Mar 1935, *W.A. Archer 3241* (US); vicinity of Pamplona, 2300–2400 m, 27 Feb 1927, *E.P. Killip & A.C. Smith 19782* (US). **Santander:** vicinity of California, 2000 m, 11–27 Jan 1927, *E.P. Killip & A.C. Smith 16846* (US). **Unknown department:** *J.C. Mutis 5518* (US), *J.J. Triana 292* (US).

17. Eragrostis pectinacea (Michx.) Nees, Fl. Afr. Austral. Ill. 406. 1841. var. **pectinacea (Fig. 12, A–E)**.

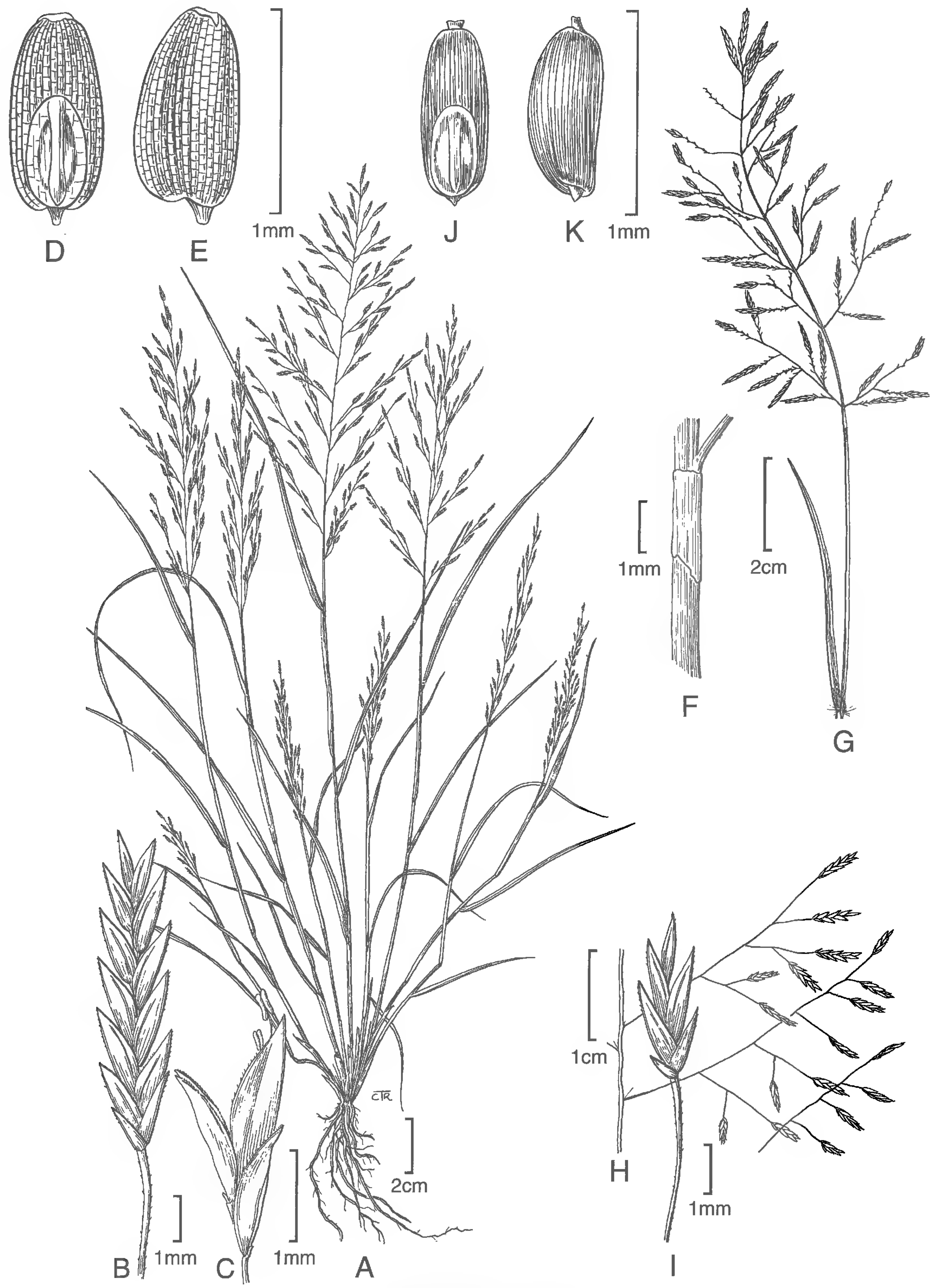
Poa pectinacea Michx., Fl. Bor.-Amer. 1:69. 1803. Type: U.S.A. Illinois: *Michaux s.n.* (holotype: P-MICH!; isotype: US-2851264 fragm. ex P!).

Eragrostis diffusa Buckley, Proc. Acad. Nat. Sci. Philadelphia 14:97. 1862. *Eragrostis purshii* var. *diffusa* (Buckley) Vasey, Contr. U.S. Natl. Herb. 1(2):59. 1890. Type: U.S.A. Texas: *S.B. Buckley* (lectotype: PH designated by Hitchcock, Man. Grasses U.S. 849. 1935, without citing a specific sheet or a specific herbarium; isolectotype: US-91621!).

Caespitose annuals without glandular pits. Culms 10–80 cm tall, erect to geniculate or decumbent below, glabrous. Leaf sheaths overlapping below, ½–3/4 as long as the internodes above, hirsute at the apices, hairs to 4 mm long; ligules 0.2–0.5 mm long; blades 2–20 cm × 1–4.5 mm, flat to involute, abaxial surfaces glabrous and smooth, adaxial surfaces scabridulous. Panicles 5–25 × 3–12(–15) cm, ovoid to pyramidal, usually open, sometimes contracted, primary branches 0.6–8.5 cm long, appressed or slightly diverging to 20° from the rachises, solitary or paired at the lowest 2 nodes; pulvini glabrous or sparsely hairy; pedicels 1–7 mm long, flexible, appressed to widely divergent, sometimes capillary. Spikelets 3.5–11 × 1.2–2.5 mm, 6–22-flowered, linear-oblong to narrowly lanceolate, plumbeous, yellowish brown, or dark reddish purple; disarticulation acropetal, paleas persistent; glumes 0.5–1.7 mm long, subequal, subulate to ovate-lanceolate, hyaline; lower glumes 0.5–1.5 mm long, at least 1/2 as long as the adjacent lemmas; upper glumes 1–1.7 mm long, usually broader than the lower glumes; lemmas 1–2.2 mm long, ovate-lanceolate, hyaline to membranous, grayish green proximally, reddish purple distally, lateral veins moderately conspicuous; apex acute; paleas 1–2 mm long, hyaline to membranous, keels scabridulous; apex obtuse; stamens 3; anthers 0.2–0.4 mm long, purplish. Caryopses 0.5–1.1 mm long, rectangular-prismatic, slightly laterally flattened, striate and reticulate, rectangular with nearly equal sides in cross-section, brownish. $2n = 60$ (Koch 1974; Davidse 1981).

Distribution and habitat.—Native to the Americas; found in North America, Central America, the Caribbean, and most of South America (not known from Chile); it grows in disturbed sites such as roadsides, railroad embankments, city sidewalks, gardens, and cultivated fields; 50–2600 m (Peterson & Boechat 2001).

Vernacular name.—"Hierba canto" (Huila, Giraldo-Cañas 3921).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1mm

Fig. 12. *Eragrostis pectinacea* (*P.M. Peterson & N.F. Refulio-Rodriguez 13981*, D & E). **A.** Habit. **B.** Spikelet. **C.** Floret with two paleas attached below. **D.** Caryopsis, dorsal view. **E.** Caryopsis, lateral view. *Eragrostis pilosa* (*S. Llatos 1107*, J & K). **F.** Portion of culm with glandular area. **G.** Culm. **H.** Inflorescence. **I.** Spikelet. **J.** Caryopsis, dorsal view. **K.** Caryopsis, lateral view.

Specimens examined. **COLOMBIA. Antioquia:** Mun. Sabaneta, parque central de la municipalidad, 1550 m, 3 Jan 2003, *D. Giraldo-Cañas 3427* (COL); Valle de Aburrá, Mun. Itagüí, parque principal del Barrio Simón Bolívar, 1550 m, 4 Dec 2004, *D. Giraldo-Cañas 3819* (COL); Valle de Aburrá, Mun. Envigado, en grietas de andenes y pavimentos del estacionamiento del supermercado "Almacenes Éxito," 1550 m, 4 Dec 2004, *D. Giraldo-Cañas 3820, 3822, 3823* (COL, US); Medellín, 1500 m, 11 Jun 1930, *W.A. Archer 102* (US); Mun. Medellín, predios de la Universidad de Antioquia, 1450 m, 25 Sep 1986, *R.W. Pohl 15601* (HUA, MO, US). **Bogotá D. C.:** Bogotá, unidad deportiva El Salitre, área peatonal, Calle 63 con Avenida 68, 2600 m, 26 Jul 2005, *D. Giraldo-Cañas 3964* (COL, HUA, US); Bogotá, La Picota, 2600 m, Feb 1934, *E. Pérez-Arbeláez 4755* (COL, US). **Boyacá:** Mun. Santa María, en un área del casco urbano principal, 900 m, 27 Sep 2007, *D. Giraldo-Cañas 4121* (COL); Soatá, dry eastern slopes, 1800 m, 17 Sep 1938, *J. Cuatrecasas 1957* (COL, US); 2 km from Soatá towards Tipacoque, 1800 m, 3 Nov 1985, *J.R.I. Wood 5132* (COL). **Caquetá:** Mun. Florencia, grietas de las aceras del centro de la ciudad, 280 m, 27–30 Jun 2005, *D. Giraldo-Cañas 3962* (COAH, COL, US). **Casanare:** Mun. El Yopal, en áreas urbanas del centro de la ciudad, 400 m, 31 Oct 2007, *D. Giraldo-Cañas 4132, 4135* (COL). **Cauca:** Mun. Popayán, predios internos y jardineras abandonadas de la Facultad de Educación de la Universidad del Cauca, 1750 m, 7–11 Nov 2004, *D. Giraldo-Cañas 3802* (COL). **Chocó:** Mun. Quibdó, en inmediaciones de la penitenciaría municipal, calle 26 con carrera 10, 90 m, 6 Nov 2005, *D. Giraldo-Cañas 3969, 3970* (COL, HUA). **Cundinamarca:** Entre Girardot y Tocaima, 326 m, Oct 1934, *H. García-Barriga 2417* (COL, US); Provincia de Río Negro, Mun. Pacho, carretera Pacho-La Capilla, alrededores del estadio municipal de fútbol, 1600 m, 13 Jan 2004, *D. Giraldo-Cañas 3724, 3727, 3732* (COL); Mun. Nilo, hacienda La Guaira, río Pagüey, 350 m, 16 Oct 2004, *D. Giraldo-Cañas 3775, 3780* (COL); Tocaima, Dec 1932, *E. Pérez-Arbeláez 2418* (COL, US). **Huila:** Mun. San Agustín, parque arqueológico San Agustín, márgenes del camino principal del parque arqueológico, 1700 m, 1–5 Jul 2005, *D. Giraldo-Cañas 3919-A* (COL); Mun. San Agustín, parque arqueológico San Agustín, andenes del Centro Administrativo del parque arqueológico, 1700 m, 1–5 Jul 2005, *D. Giraldo-Cañas 3921* (COL); Mun. Timaná, en grietas de los andenes del casco urbano, 1500 m, 1–5 Jul 2005, *D. Giraldo-Cañas 3926* (COL). **Meta:** Mun. Villavicencio, en un área urbana, calles del parque Los Centauros, 400 m, 10 Nov 2002, *D. Giraldo-Cañas 3341* (COL, US). **Quindío:** Mun. Quimbaya, parque principal, aceras y pavimentos, 1500 m, 20–25 May 2005, *D. Giraldo-Cañas 3889* (COL, HUA). **Santander:** Mun. Barbosa, en grietas de pavimentos y aceras, cerca de la Plaza Principal, 1700 m, 20 Jul 2003, *D. Giraldo-Cañas 3563* (COL). **Tolima:** Cordillera Central andina, Mun. Ibagué, jardineras y andenes de la Plaza de Bolívar, 1200 m, 11–12 Jun 2005, *D. Giraldo-Cañas 3910* (COL, HUA, US). **Valle del Cauca:** Estación Piedras, entre Obando y Cartago, 980 m, 5 Feb 1961, *J.M. Idrobo 4249* (COL).

18. Eragrostis pilosa (L.) P. Beauv. Ess. Agrostogr. 71:162, 175. 1812. subsp. **pilosa (Fig. 12, F–K)**. *Poa pilosa* L., Sp. Pl. 1:68. 1753. TYPE: "*Gramin paniculis elegantissimis, majus, locustis, purpureo-spadiceis, minoribus*" in Scheuchzer, Agrostographia: 193, t. 4, f. 3. 1719 (LECTOTYPE, designated by Du Puy et al., Fl. Australia: 472. 1993). [EPITYPE: ITALY, 9–10 Aug 1902, *A. Kneucker, Gram. Exsicc. XII, 344*, (EPITYPE: B! designated by H. Scholz in Cafferty et al., Taxon 49:256. 2000; US-557051!)].

Caespitose annuals. Culms 8–45(–70) cm tall, erect or geniculate spreading below, glabrous or occasionally with a few glandular pits. Leaf sheaths overlapping below, about 1/2 to as long as the internodes above, ciliate at the summit and collar or glabrous, the hairs up to 3 mm long; ligules 0.1–0.5 mm long, ciliate; blades 2–15(–20) cm × 1–2.5(–4) mm, flat, scaberulous above and glabrous below with a few hairs near the base. Panicles 4–20(–28) × 2–15(–18) cm, ellipsoid to ovoid, open, diffuse, the ascending, capillary often drooping, primary branches 1–10 cm long, spreading 10–80°(–110°) from the rachises, usually whorled on the lowest two nodes, glabrous to scaberulous; pulvini glabrous to occasionally sparsely ciliate; pedicels 0.8–10 cm long, erect to flexuous, appressed to spreading, scaberulous. Spikelets (2–)3.5–6(–10) × 0.6–1.3(–1.8) mm, (3-) 5- to 17-flowered, linear-oblong to narrowly ovate, plumbeous; disarticulation acropetal with the glumes first then the lemmas and paleas falling individually, paleas easily deciduous; glumes 0.3–1.2 mm long, narrowly ovate to lanceolate, hyaline, keeled, scaberulous along the keel; lower glume 0.3–0.6(–0.8) mm long; upper glume 0.7–1.2(–1.4) mm long, usually broader than the lower; lemmas 1.2–1.8 mm long, ovate-lanceolate, hyaline to membranous, grayish green below and reddish purple near the apex, keeled, scaberulous along the keel near apex, lateral nerves inconspicuous; apex acute; paleas 1–1.6 mm long, hyaline to membranous, scaberulous along the keels; apex obtuse; stamens 3, anthers 0.2–0.3 mm long, purplish. Caryopses 0.5–1 mm long, obovoid to prism-shaped, dorsally flattened, smooth to striate, rectangular in cross-section, light brown. $2n = 20, 36, 40$ (Bir & Sahni 1988).

Distribution and habitat.—Native in Europe, naturalized in North, Central, and South America (excluding Surinam); occurs in disturbed habitats and along forest margins in sandy or gravelly sites and city sidewalks; 0–1700 m (Peterson & Boechat 2001).

Vernacular name.—"Maleza del arroz" (Tolima, F.A. Montealegre 11).

Specimens examined. **COLOMBIA. Antioquia:** Medellín, 1500 m, 2 Jul 1930, *W.A. Archer 317* (US); Mun. Urrao, carretera a La Encarnación, 10 km al noroeste de Urrao, 1650 m, 10 Sep 1986, *R.W. Pohl & J. Betancur 15478* (HUA, MO, US); vicinity of Medellín, 5 Jul

1927, *R.A. Toro 264* (US). **Arauca:** Mun. Arauca, inmediaciones de las instalaciones de la Universidad Nacional de Colombia, hacienda El Cairo, carretera Arauca-Tame, km 9, 200–300 m, 13 Jun 2003, *D. Giraldo-Cañas 3493* (COL). **Bolívar:** along the Mompós-Juana Sánchez trail, Island of Mompós, lands of Loba, Apr-May 1916, *H.M. Curran 244* (US), *246* (US). **Casanare:** Mun. El Yopal, en áreas urbanas del centro de la ciudad, 400 m, 31 Oct 2007, *D. Giraldo-Cañas 4131, 4138* (COAH, COL). **Cundinamarca:** Mun. Nilo, hacienda La Guaira, río Pagüey, 350 m, 16 Oct 2004, *D. Giraldo-Cañas 3772* (COL); between Anolaima and Cachipay, 17 Apr 1935, *W.A. Archer 3328* (US). **La Guajira:** Pájaro, 10 m, 28 Nov 1959, *J. Cuatrecasas & R. Romero-Castañeda 25474* (COL, US); Clausura Napaipa, rumbo a Maicao, 4.5 km de Uribia, 13 Feb 1963, *C. Saravia 2224* (COL, US). **Magdalena:** Santa Marta, 1898–1899, *H.H. Smith 2150* (COL, MO, US). **Meta:** Mun. Villavicencio, carretera Villavicencio-Aeropuerto, piedemonte de la cordillera Oriental, sitio La Arenera, ca. 2 km del puente sobre el río Guatiquía, ca. 400 m, 10 Nov 2002, *D. Giraldo-Cañas 3342-A* (COL), 14–15 Dec 2002, *D. Giraldo-Cañas 3388* (COAH, COL, HUA). **Nariño:** Mun. Pasto, Panamericana, puente del Juanambú, 1000 m, 20 May 1989, *B.R. Ramírez 1489* (COL, PSO). **Quindío:** Mun. Armenia, Avenida Bolívar, Parque de La Vida, 1500 m, 29 Jul 2007, *D. Giraldo-Cañas & J.C. Ospina 4095* (COL, HUA). **Santander:** Granja Apropecuaria Piedecuesta, al sur de Bucaramanga, 1000 m, 6 Oct 1966, *A. Robinson 3165* (US); Mesa de los Santos, al sur de Bucaramanga, 1700 m, 30 Dec 1966, *A. Robinson 3207* (US). **Tolima:** Ibagué, vereda Chucuni, finca Reinoso, 1100 m, 2 Jul 2006, *F.A. Montealegre 11* (COL). **Valle del Cauca:** Cartago, Santa Ana de los Caballeros, 950 m, 19 Nov 1946, *J. Cuatrecasas 23023* (US), *23037* (COL, US); between Uribe and Sevilla, 1100 m, 2 Nov 1983, *J.R.I. Wood 4084* (COL).

19. Eragrostis polytricha Nees, Fl. Bras. Enum. Pl. 2:507–508. 1829. (**Fig. 8, F–H**). *Poa polytricha* (Nees) Kunth, Enum. Pl. 1:331. 1833. Type: BRAZIL: *Sellow s.n.* (holotype: B; isotypes: BAA-2668 fragm. ex B!, US-77386 fragm.!).

Eragrostis lugens var. *villosa* Döll, Fl. Bras. 2(3):140. 1878. Type: BRAZIL. Minas Gerais: Caldas, 28 Mar 1868, *Exp. Regnell III 1405* (lectotype: S designated by Boechat & Longhi-Wagner, Iheringia, Bot. 55:117. 2001; isolectotype: US!).

Eragrostis floridana Hitchc., Amer. J. Bot. 2:308. 1915. *Eragrostis trichocolea* var. *floridana* (Hitchc.) Witherspoon, Ann. Missouri Bot. Gard. 64:328. 1977. Type: U.S.A. Florida: Hillsborough Co., near Tampa, Mar, *Curtiss 3494* (holotype: US-726520!; isotypes: BR, F, ISC, LE, M, MO!, NY!, PH, TAES, TENN, US-748356!, US-823092!).

Eragrostis fragilis Swallen, Fieldiana, Bot. 28(1):18. 1951. Type: VENEZUELA. Bolívar: Gran Sabana, between Kun and Uaduara-parú, in valley of Río Kukenán, S of Mount Roraima, 1065–1220 m, 1 Oct 1944, *J.A. Steyermark 59062* (holotype: US-1911657!; isotypes: F, VEN).

Caespitose perennials with innovations, without rhizomes, not glandular. Culms 30–62 cm tall, erect, glabrous and shiny below the nodes. Leaf sheaths sometimes densely pilose dorsally and on the collars, margins and apices hairy, hairs to 5 mm; ligules 0.2–0.4 mm long; blades 5–20(–33) cm long, 1–3.5 mm wide, involute to flat, both surfaces with scattered hairs, adaxial surfaces densely hairy behind the ligules, hairs to 7 mm long. Panicles 15–25 cm long, 5–27 cm wide, ovate, open; primary branches 0.6–15 cm long, diverging up to 90° from the rachises, capillary, naked basally; pulvini hairy, hairs to 8 mm long; pedicels 1.4–10(–16) mm long, divergent. Spikelets (2.5–)3–5 mm long, 1.1–1.6 mm wide, 4–9-flowered, narrowly lanceolate to linear-oblong, plumbeous; disarticulation acropetal, paleas persistent; glumes broadly ovate to narrowly lanceolate, hyaline to membranous; lower glumes 1.1–1.6 mm long; upper glumes 1.2–1.8 mm long; lemmas 1.2–1.8 mm long, broadly ovate, membranous throughout, lateral veins inconspicuous, apices acute; paleas 1.1–1.7 mm long, membranous to hyaline, narrower than the lemmas, apices obtuse; stamens 3, anthers 0.3–0.5 mm long, reddish-purple. Caryopses 0.5–0.8 mm long, obovoid to somewhat prism-shaped, laterally compressed, with a well-developed adaxial groove, finely striate, opaque to translucent, reddish-brown. $2n = 60, 80$.

Distribution and habitat.—*Eragrostis polytricha* grows in sandy and rocky areas, usually in open savannas; 0–2650 m. *Eragrostis polytricha* ranges from México through Central America to Argentina, Bolivia, Brazil, Chile, Colombia, Guyana, Paraguay, Uruguay, and Venezuela (Boechat & Longhi-Wagner 2001).

Specimens examined. **COLOMBIA. Cundinamarca:** Hoya del río Checua Loma, 250 m SE de San José, arenas del Cacho, 2640 m, 8 Dec 1966, *Schrimpff 122* (COL).

20. Eragrostis prolifera (Sw.) Steud., Syn. Pl. Glumac. 1:278. 1854. (**Fig. 13, A–D**). *Poa prolifera* Sw., Prodr. 27. 1788. Type: GUADELOUPE: *Swartz s.n.* (holotype: S; isotype: K!).

Eragrostis salzmannii Steud., Syn. Pl. Glumac. 1:277. 1854. Type: BRAZIL. Bahia: *P. Salzmann s.n.* (isotypes: K-photo!, US-911901!, US-2767414!).

Caespitose perennials with innovations, without rhizomes, not glandular. Culms 85–130(150) cm tall, stiffly erect, glabrous below the nodes. Leaf sheaths glabrous or hairy at the apices, hairs to 4 mm long; ligules

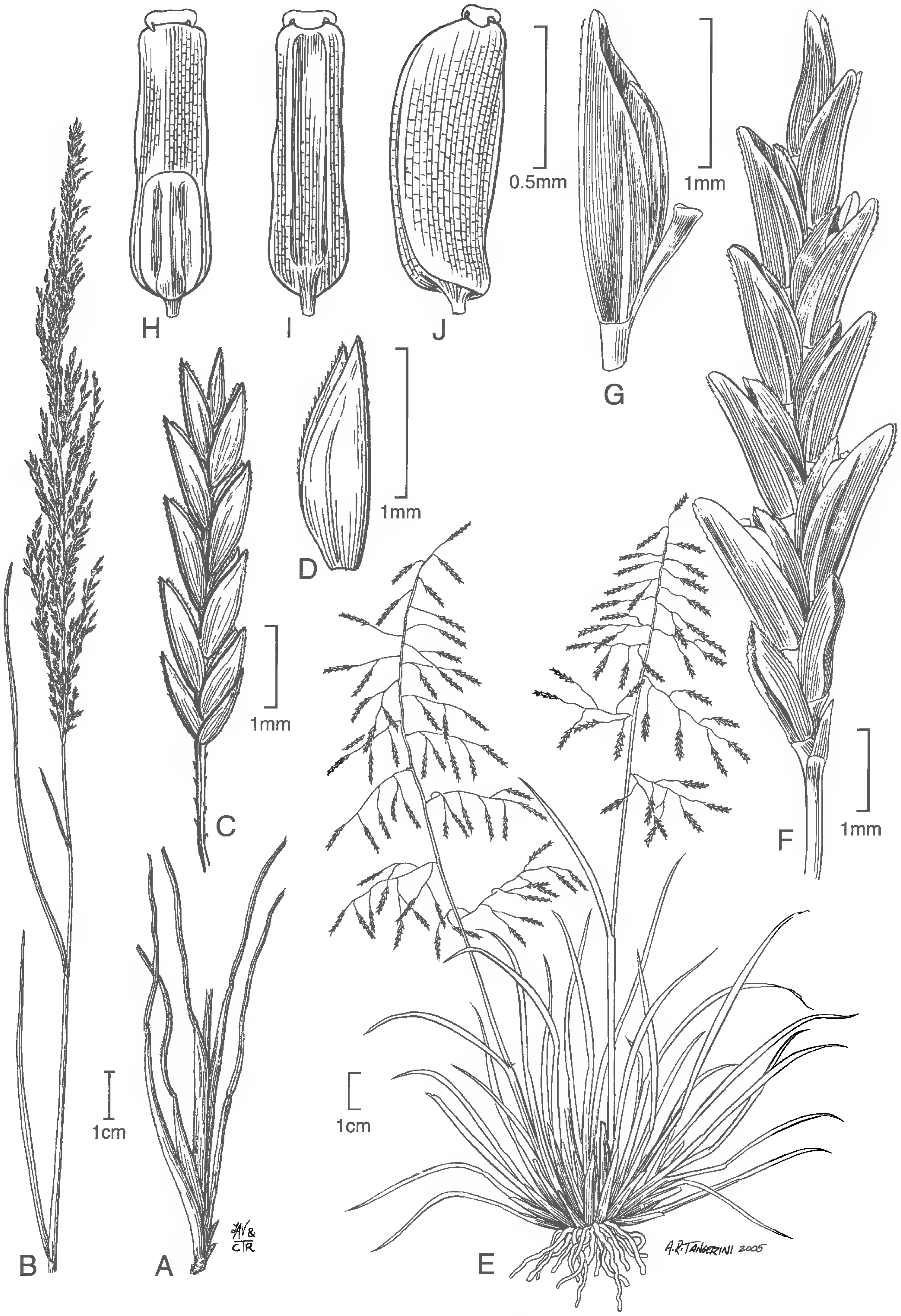
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Fig. 13. *Eragrostis prolifera*. A. Habit. B. Culm. C. Spikelet. D. Floret. *Eragrostis tenuifolia* (*P.M. Peterson & O. Tovar 14049*, E–G; *P. Nuñez & V.&E. Bengoa 8731*, H–J). E. Habit. F. Spikelet. G. Floret. H. Caryopsis, dorsal view. I. Caryopsis, ventral view. J. Caryopsis, lateral view.

0.1–0.2 mm long; blades 25–50 cm long, 1.5–6 mm wide, flat to involute, glabrous abaxially, scabridulous adaxially, sometimes also with a few scattered hairs near the base. Panicles (10)20–50(60) cm long, 2–8(10) cm wide, narrowly ovate, contracted to open; primary branches mostly 2–14 cm long, appressed or diverging up to 50°(–90°) from the rachises, spikelets congested near the base of the branches; pulvini glabrous; pedicels 0.3–2.4 mm long, appressed, always shorter than the spikelets. Spikelets 3.2–10(12) mm long, 0.7–1.4 mm wide, (5)8–25-flowered, linear-lanceolate, stramineous to plumbeous, sometimes with a reddish tinge; disarticulation acropetal, glumes first, then the lemmas, paleas persistent; glumes subequal, ovate to lanceolate, hyaline; lower glumes 1–1.5 mm long; upper glumes 1.1–1.6 mm long; lemmas 1.1–1.8(2) mm long, ovate, membranous, apices acute; paleas 0.8–1.7 mm long, hyaline, narrower than the lemmas, apices obtuse to truncate; stamens 2, anthers 0.2–0.3 mm long, purplish. Caryopses 0.6–0.9 mm long, ovoid, flattened ventrally, finely striate, reddish-brown. $2n = 40$.

Distribution and habitat.—*Eragrostis prolifera* grows on beaches, in brackish water, and along roadsides, at elevations below 20 m. Its range extends southward from U.S.A. through México and Central America to Brazil, Colombia, and Venezuela (Boechat & Longhi-Wagner 2001). Boechat and Longhi-Wagner (2001) reported *E. prolifera* as occurring in Peru but no specimens were seen by PMP in a treatment of *Eragrostis* in Peru (Peterson & Sánchez Vega 2007).

Specimens examined. **COLOMBIA. Atlántico:** Puerto Colombia, Sabanilla, 21 Nov 1912, *A.S. Hitchcock 9931* (US). **Bolívar:** Cartagena and vicinity, Dec 1928, *B. Elías 649* (COL, US); Cartagena, Mamonal, lechos de sedimentación, 0–20 m, 16 Nov 1990, *R. Álvarez 12* (COL); Boca Grande, near Cartagena, 0–5 m, 3 Nov 1926, *E.P. Killip & A.C. Smith 14097* (COL, US), *14103* (MO, US); Cartagena, sand beach, 20 Nov 1912, *A.S. Hitchcock 9900* (US), *9902* (US); Cartagena, 0–2 m, 1–3 Oct 1922, *F.W. Pennell 12013* (US); Costa Caribe, Alrededores de Cartagena, 5 m, year 1942, *H. Apolinar 392* (COL); Islas del Rosario, 2 m, 14–17 Oct 1963, *P. Pinto 685, 687, 701* (COL); Cartagena, playas de Marbella, 0–5 m, 3 Feb 1962, *C. Saravia & D. Johnson 31, 66* (COL). **San Andrés, Providencia y Santa Catalina:** Santa Catalina Island, near the village, 0–5 m, 5 Feb 1985, *J.R.I. Wood 4729* (COL). **Sucre:** Mun. Tolú, arroyo Amansaguapos, glofo de Morrosquillo, Manglares, 0–5 m, 18 Sep 1990, *J. Betancur & M. Berrío 1970* (COL, HUA, MO).

21. Eragrostis rufescens Schrad. ex Schult. var. **rufescens**, Mant. 2:319. 1824. (**Fig. 10, E–H**). *Eragrostis inconstans* var. *rufescens* (Schrad. ex Schult.) Nees, Fl. Bras. Enum. Pl. 2(1):495. 1829. Type: BRAZIL: *Maximilian Neowidens s.n.* (holotype: LE; isotype: BAA-1087!).

Eragrostis polyneura Jedwabn., Bot. Arch. 5(3–4):205. 1924. Type: BRAZIL: *A.F.M. Glaziou 18559* (isotype: US-79710 fragm.!).

Eragrostis acicularis Trin., Mém. Acad. Imp. Sci. St.-Pétersbourg, Sér. 6, Sci. Math. 1(4):406. 1830. Type: BRAZIL. Paraná: in arenosis ad ripas fluv., Rio Jacaré, Dec, *Riedel 1140* (holotype: LE-TRIN-2299.01!; isotypes: K, LE, P, SI, US-2891442!, US-2765424 fragm.!).

Eragrostis affinis Salzm. ex Steud., Syn. Pl. Glumac. 1:277. 1854. Type: BRAZIL. Bahia: in maritimis, 1838, *T. Salzmann s.n.* (holotype: LE-TRIN-2572.01!; isotypes: K, LE-TRIN-2572.02!, MO, US-2767409!, US-911819!, US-1614948!).

Eragrostis multipes S. Moore, Trans. Linn. Soc. London, Bot. 4:511. 1895. Type: BRAZIL. Brasilia: Hab. in cacumine montium Serra de Chapada prope Santa Anna de Chapada, Matto Grosso Exped, Spencer Le M. Moore, Botanist 131 (holotype: BM!).

Caespitose annuals with innovations, not glandular. Culms 5–45(–70)–35 cm tall, erect or decumbent, often geniculate near base, glabrous below the nodes. Leaf sheaths shorter than the internodes, hairy at the apices, hairs to 4 mm long; ligules 0.1–0.3 mm long; blades 6–20 cm long, (1–)2–3.5(–4) mm wide, flat to involute, glabrous abaxially, scabridulous adaxially and with scattered hairs, the hairs 2–4 mm long and more numerous near base. Panicles (3–)5–19 cm long, 1–6.5(–8.5) cm wide, ovate to narrowly oblong, contracted to open; primary branches mostly 2–8 cm long, appressed or diverging up to 50° from the rachises; pulvini hairy to glabrous; pedicels 1–2 mm long, appressed, always shorter than the spikelets. Spikelets (5–)6–15(–21) mm long, 1.5–2.2(–3) mm wide, 10–43-flowered, linear-lanceolate, imbricate, stramineous to plumbeous to reddish-purple tinged; disarticulation acropetal, glumes first, then the lemmas, paleas persistent; glumes 1.4–2.6 mm long, subequal, narrowly lanceolate, membranous, 1-keeled, 1-nerved; lower glumes 1.4–2.5 mm long; upper glumes 1.5–2.6 mm long; lemmas 1.6–2.3 mm long, ovate-acuminate, chartaceous to coriaceous, lateral nerves evident, apices acuminate; paleas (0.8–)1.2–1.5 mm long, hyaline, narrower than the lemmas, apices obtuse to truncate; stamens 2, anthers 0.2–0.3 mm long, reddish-brown to dark-purplish. Caryopses 0.4–0.6 mm long, ovoid, smooth to finely striate, light reddish-brown with a dark mark near base of the embryo. $2n = 60$ (Davidse 1994).

Distribution and habitat.—*Eragrostis rufescens* var. *rufescens* is an American species and is distributed from Mesoamerica to Bolivia, Brazil, Paraguay, and Venezuela (Boechat & Longhi-Wagner 2001). This species grows in savanna grasslands in open, sandy areas along rivers and in flats that are periodically flooded by water, along roadsides, city sidewalksm, and cultivated fields; 1500–2500 m. This is the first report of *E. rufescens* for the Colombian flora.

Comments.—Morphologically, *E. rufescens* is very similar to *E. pectinacea*. Nevertheless, *E. rufescens* has longer glumes (1.4–2.6 mm long versus 0.5–1.7 mm long in *E. pectinacea*), only two stamens (versus three in *E. pectinacea*), and ovoid caryopses (versus rectangular-prismatic in *E. pectinacea*).

Specimens examined. **COLOMBIA. Antioquia:** Medellín, 27 Apr 1927, *R.A. Toro 243* (US). **Boyacá:** Cordillera Oriental, along Río Soapaga, 12 km E of Belén, 2460 m, 7 Nov 1944, *F.R. Fosberg 22208* (US).

22. Eragrostis secundiflora J. Presl, Reliq. Haenk. 1 (4–5):276. 1830. subsp. **secundiflora (Fig. 6, I–K).** *Poa secundiflora* (J. Presl) Kunth, Enum. Pl. 1:342. 1833. Type: MÉXICO: *T. Haenke s.n.* (holotype: PR; isotypes: photo K!, LE, MO-123764!, US-79720 fragm. ex PR!).

Eragrostis compacta Salzm. ex Steud., Syn. Pl. Glumac. 1:275. 1854. Type: BRAZIL. Bahia: *P. Salzmann s.n.* (holotype: P!; isotypes: K!, MO!, US-911749!, US-911748!).

Eragrostis yucatana L.H. Harv., Bull. Torrey Bot. Club 81(5):406. 1954. Type: MÉXICO. Yucatan: near Progreso, 11–15 Aug 1932, *J.R. Swallen 2933* (holotype: US-1537194!).

Caespitose perennials with innovations, not glandular. Culms 30–75 cm tall, erect, glabrous below. Leaf sheaths overlapping below, ½ as long as the internodes above, mostly glabrous, hairy at the apices, hairs to 4 mm long; ligules 0.2–0.3 mm long; blades 10–25(–40) cm long, 1–5 mm wide, involute, glabrous abaxially, scabridulous adaxially, sometimes also sparsely pilose. Panicles (3–)5–30 cm long, 1–15 cm wide, from narrowly oblong, glomerate, and interrupted below to ovate and open; primary branches 0.5–12(–16) cm, appressed or diverging up to 40° from the rachises, stiff; pulvini glabrous or sparsely hairy; pedicels 0–1(–3) mm, appressed, flattened. Spikelets 6–16(–23) cm long, 2.4–5 mm wide, ovate to linear-elliptic, flattened, stramineous, with reddish-purple margins or completely reddish-purple, with 10–45 florets; disarticulation basipetal, florets falling intact and before the glumes; glumes ovate-lanceolate to lanceolate, membranous; lower glumes 1.7–3 mm long; upper glumes 2.2–4 mm long, apices acuminate; lemmas 2–6 mm long, ovate, membranous to leathery, apices usually acuminate or attenuate, sometimes acute; paleas 1.5–3 mm long, membranous to leathery, narrower than the lemmas, apices obtuse, sometimes bifid; stamens 2, anthers 0.2–0.5 mm long, brownish. Caryopses 0.8–1.3 mm long, ellipsoid, somewhat laterally flattened, smooth, reddish-brown. $2n = 40$.

Distribution and habitat.—*Eragrostis secundiflora* subsp. *secundiflora* occurs throughout México, and in South America it is found in Bolivia, Brazil, Guyana, Peru, and Venezuela. This species grows in sandy soils, dunes, grasslands, beaches, and roadsides; 0–1700 m.

Specimens examined. **COLOMBIA. Casanare:** Al sur de El Yopal, piedemonte andino, en abánico fluvial, sabana de *Trachypogon ligularis*, ca. 200 m, 12 Jul 1963, *J. Blydenstein & C. Saravia 1365* (COL). **Meta:** Al sur del río Guacavía, hacienda Gibraltar, en terraza aluvial, ca. 200 m, 9 Sep , *J. Blydenstein 1590* (COL). **Santander:** Mesa de los Santos, 1500 m, 11–15 Dec 1926, *E.P. Killip & A.C. Smith 15241* (US); Mesa de los Santos, al sur de Bucaramanga, 1700 m, 30 Dec 1966, *A. Robinson 3188* (US).

23. Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult., Syst. Veg. 2:576. 1817. **(Fig. 5, F–I).** *Poa tenella* L., Sp. Pl. 1: 69. 1753. *Megastachya tenella* (L.) Bojer, Hortus Maurit. 369. 1837. Type: INDIA: *Anonymous* (lectotype: Herb. Linn. 87.33-LINN! designated by Veldkamp, Blumea 47:164. 2002, IDC microfiche US!).

Poa amabilis L., Sp. Pl. 68. 1753. *Eragrostis amabilis* (L.) Wight & Arn., Bot. Beechey Voy. 251. 1838, *hom. illeg. Megastachya amabilis* (L.) P. Beauv., Ess. Agrostogr. 74, 167, 173. 1812. *Cynodon amabilis* (L.) Raspail, Ann. Sci. Nat., Bot. 5:302. 1825. Type: SRI LANKA: *Herb. Hermann 2: 59, no. 46* [lectotype: BM! designated by Veldkamp in Cafferty et al., Taxon 49:254. 2000, IDC microfiche US!].

Poa plumosa Retz., Observ. Bot. 4:20. 1786. *Eragrostis plumosa* (Retz.) Link, Hort. Berol. 1:192. 1827. *Eragrostis tenella* var. *plumosa* (Retz.) Stapf, Fl. Brit. India 7(22):315. 1897 (1896). *Eragrostis amabilis* var. *plumosa* (Retz.) E.G. Camus & A. Camus, Fl. Indo-Chine 7: 557. 1923. Type: INDIA: E. Tranquebaria, *König s.n.* (holotype: LD; isotype: K fragm.!).

Eragrostis ciliaris var. *patens* Chapm. ex Beal, Grasses N. Amer. 2:479. 1896. Type: U.S.A. Georgia. Wayne Co.: Doctortown and Jesup, Sep–Oct 1880, *A.H. Curtiss 3493* (holotype: MSC; isotypes: NY!, US-748296!, US-821866!, US-909340!).

Caespitose annuals. Culms 5–40(–50) cm tall, erect to spreading, mostly glabrous and occasionally with oblong glandular areas below the nodes. Leaf sheaths 1/2 as long as the internodes, ciliate at the summit, collar, and along margins of the upper portion, the hairs to 4 mm long, stiff; ligules 0.2–0.3 mm long, ciliate; blades 2–8 cm × 2–4 mm, flat to involute, glabrous below and scaberulous above, occasionally with a few scattered papillose-based hairs below. Panicles 4–15 × 1–7 cm, open, narrowly ovate, primary branches 0.5–4 cm long, sometimes with irregular glandular areas below the branch bases, branches diverging 20–100° from the rachises; pulvini ciliate or glabrous; pedicels 0.8–4(–7) mm long, mostly pendant, drooping to erect. Spikelets (1–)1.5–2.2 × 0.9–1.2 mm, 4–8-flowered, ovate to oblong, reddish-purple to greenish; disarticulation between the florets with a portion of the rachilla; glumes 0.4–1.1 mm long, unequal, ovate, hyaline, keeled, the nerve commonly green, scaberulous along the keel; lower glumes 0.4–0.7 mm long; upper glumes 0.7–1.1 mm long; lemmas 0.7–1.1 mm long, ovate to broadly oblong, membranous, lateral nerves evident, usually greenish, strongly keeled, scaberulous along keel; apex truncate to obtuse; paleas 0.6–1.1 mm long, hyaline, keels ciliate, the cilia 0.3–0.5 mm long; apex obtuse to truncate; stamens 3, anthers ca. 0.2 mm long, purplish. Caryopses 0.3–0.5 mm long, ellipsoid, faintly striate, elliptical to circular in cross-section, translucent, light brown. $2n = 20$ (Baquar & Saeed 1969).

Distribution and habitat.—Native in India; introduced in U.S.A., Mexico, Central America, Caribbean, Brazil, Bolivia, Ecuador, Guianas, Paraguay, Peru, and Venezuela (Nicora 1998; Peterson & Boechat 2001); occurs in open areas near cultivated fields, dry forests, city sidewalks, and along roadsides; 0–1600(–2700) m.

Vernacular names.—"Grama ilusión" (Atlántico, *Dugand 5866*), "Paja ilusión" (Norte de Santander, *Carvajalino & Díaz 43*).

Comments.—Based on unpublished research by Otto Stapf, Bor (1960) pointed out that *Eragrostis amabilis* (L.) Wight & Arn. is the same species as *E. tenella*. Since Hooker (1896:315, cited by Koch 1978) was the first to unite the two, and he used the latter name, *E. tenella* is the correct name for this species (Koch 1978).

Specimens examined. **COLOMBIA. Antioquia:** Mun. Medellín, predios internos del Jardín Botánico Joaquín Antonio Uribe, 1550 m, 2 Jan 2002, *D. Giraldo-Cañas 3293* (COL, HUA); Valle de Aburrá, Mun. Envigado, creciendo en las grietas de andenes y pavimentos del estacionamiento del supermercado "Almacenes Éxito," 1550 m, 4 Dec 2004, *D. Giraldo-Cañas 3821* (COL); Medellín, 1500 m, 11 Jun 1930, *W.A. Archer 101* (US), Oct 1945, *A. Fernández s.n.* (US-2765421). **Arauca:** Mun. Arauca, inmediaciones de las instalaciones de la Universidad Nacional de Colombia, hacienda El Cairo, carretera Arauca-Tame, km 9, 200–300 m, 13 Jun 2003, *D. Giraldo-Cañas 3500, 3507* (COL). **Atlántico:** Barranquilla, campus de la Universidad del Norte, carretera Barranquilla-Puerto Colombia, km 5, 5–10 m, 11 Oct 2007, *D. Giraldo-Cañas 4123, 4127* (COL); Puerto Colombia, 15 Mar 1949, *A. Dugand 4308* (COL, US), 21 Nov 1912, *A.S. Hitchcock 9935* (US); Barranquilla, barrio Altos del Prado, 50–70 m, 1 Nov 1961, *A. Dugand 5866* (COL). **Bolívar:** Cartagena, near shore, 20 Nov 1912, *A.S. Hitchcock 9897* (US). **Caquetá:** Mun. Florencia, Barrio Villa Natalia, grietas de pavimentos y andenes, ca. 280 m, 27–30 Jun 2005, *D. Giraldo-Cañas et al. 3952* (COL). **Casanare:** Mun. El Yopal, en áreas urbanas del centro de la ciudad, 400 m, 31 Oct 2007, *D. Giraldo-Cañas 4129, 4134* (COL). **Córdoba:** Mun. Santa Cruz de Lorica, centro de Lorica, 150 m, 24 Feb 2005, *D. Giraldo-Cañas 3857* (COL); Mun. San Pelayo, carretera San Pelayo-Lorica, en huerta casera de fríjol, 150 m, 26 Feb 2005, *D. Giraldo-Cañas 3868* (COL). **Cundinamarca:** Mun. Nilo, hacienda La Guaira, río Pagüey, 300 m, 16 Oct 2004, *D. Giraldo-Cañas 3769* (COL); Mun. Girardot, vía férrea entre Girardot y Flandes, cerca de la ribera del río La Magdalena, 250 m, 17 Oct 2004, *D. Giraldo-Cañas 3785* (COL). **Magdalena:** Santa Marta, sea level, 1898–1901, *H.H. Smith 2746* (COL, MO, US). **Meta:** Mun. Villavicencio, en área urbana, calles del parque Los Centauros, 400 m, 10 Nov 2002, *D. Giraldo-Cañas 3340* (COAH, COL). **Nariño:** Mun. Ipiales, Las Lajas, 2700 m, 7 Aug 1939, *H. García-Barriga 7841-A* (COL). **Norte de Santander:** Cúcuta y El Rosario, Feb 1941, *Carvajalino & Díaz 43* (COL). **Quindío:** Mun. Quimbaya, parque principal, en jardineras, 1500 m, 20–25 May 2005, *D. Giraldo-Cañas 3891* (CAUP, COL, HUA). **Santander:** Bucaramanga, 1100 m, 4 Aug 1944, *N. C. Fassett 25585* (US); San Gil, 1250 m, year 1983, *J.R.I. Wood 3884* (COL). **Tolima:** Mun. Flandes, vía férrea entre Flandes y Girardot, cerca de la ribera del río La Magdalena, 250 m, 17 Oct 2004, *D. Giraldo-Cañas 3791* (COL); Cordillerra Central andina, Mun. Ibagué, jardineras y andenes de la Plaza de Bolívar, ca. 1200 m, 11–12 Jun 2005, *D. Giraldo-Cañas et al. 3914* (COL). **Valle del Cauca:** Plana del Valle, extremo N, Cartago, malezas en San Jerónimo, 980 m, 15 Nov 1946, *J. Cuatrecasas 22832* (COL, US). **Vichada:** Región Guayanesa, Mun. Puerto Carreño, afloramientos rocosos entre Punta de Lajas y el Cerro El Bita, ribera del río Orinoco, 40–100 m, 4–5 Jan 2004, *D. Giraldo-Cañas & C. Parra 3625* (COL).

24. Eragrostis tenuifolia (A. Rich.) Hochst. ex Steud., Syn. Pl. Glumac. 1:268. 1854. **(Fig. 13, E–J)**. *Poa tenuifolia* A. Rich., Tent. Fl. Abyss. 2:425. 1850 (1851). Type: ETHIOPIA: in locis incultis Vallium prope Adoam, 18 Sep 1837, *G.H.W. Schimper 92* (lectotype: P! designated by S. Phillips, Fl. Ethiopia 7:122. 1995; isotypes: GOET-5814, K!, L, W!, WAG, US-1127147 fragm.!).

Caespitose perennials. Culms 25–75 cm tall, erect to geniculate spreading below, glabrous, 2–3 nodes per culm. Leaf sheaths overlapping below, 3/4 to as long as the internodes above, glabrous, pilose along the margins and at the summit, the hairs up to 2 mm long; ligules 0.2–0.3 mm long, ciliate; blades 3.5–20(–30) cm × 1–3 mm, flat to folded or loosely involute, glabrous to scaberulous above and glabrous below. Panicles 5–20 × 3–10(–12) cm, open, ovate to narrowly pyramidal, with a well developed peduncle up to 18 cm long, the relatively few-flowered primary branches 0.5–6 cm long, spreading 40–90° from the rachises, solitary, scaberulous; pulvini ciliate, often reddish, the hairs up to 2 mm long; pedicels 2–15 mm long, erect, capillary and stiff, scaberulous. Spikelets 6–12(–14) × 1.5–2.2 mm, 6- to 14-flowered, linear, plumbeous; disarticulation acropetal with the glumes first then the lemmas falling, paleas mostly persistent; glumes 0.3–1 mm long, very unequal, hyaline, not keeled, glabrous; lower glumes 0.3–0.6 mm long, subulate to linear-lanceolate; upper glumes 0.5–1 mm long, lanceolate, usually broader than the lower; lemmas 1.5–2.0 mm long, ovate, membranous, plumbeous, obscurely keeled, lateral nerves obscure, scaberulous near the apex; apex acute to obtuse; paleas 1.3–1.8 mm long, membranous, plumbeous, scaberulous along the keels; apex obtuse; stamens 3, anthers 0.2–0.4 mm long, red to white in age. Caryopses 0.6–1.1 mm long, ovoid, strongly laterally flattened, and curved on the adaxial side, striate and reticulate, with a deep ventral groove, narrowly triangular in cross-section, brownish. $2n = 40$ (Pohl & Davidse 1971; Morton 1993).

Distribution and habitat.—Native in North Africa and Asia, naturalized and rapidly spreading in the New World tropics from México, Guatemala, El Salvador, Honduras, Costa Rica to Argentina, Bolivia, Chile, Ecuador, Peru, and Venezuela; along roadsides, city sidewalks, soccer fields, and disturbed open areas; 100–3400 m.

Comments.—A population of *Eragrostis tenuifolia* in the Cordillera Oriental (Choachí, Cundinamarca: *Giraldo-Cañas 3288*) has stolons and no other individuals of this species are known to have these structures.

Specimens examined. **COLOMBIA. Antioquia:** Mun. Itagüí, barrio Simón Bolívar, carrera 50 con calle 64, 1550 m, 2 Jan 2003, *D. Giraldo-Cañas 3424, 3426* (COL); Mun. Jardín, sitio La Truchería, carretera Jardín-Riosucio, km 5, 1900 m, 5 Jan 2003, *D. Giraldo-Cañas 3432* (COL); Mun. Envigado, loma de El Escobero, 2 km antes de la intersección con la carretera Las Palmas, 1850 m, 26 Dec 2003, *D. Giraldo-Cañas 3619* (COL); Mun. Andes, aeropuerto, 1200 m, 17 Sep 1986, *R.W. Pohl & J. Betancur 15523* (COL, HUA, MO, US); Mun. Jardín, vereda Las Manguitas, 18 km oeste de Jardín, 1600 m, 19 Sep 1986, *R.W. Pohl & J. Betancur 15550* (COL, HUA, MO, US). **Boyacá:** Mun. Iza, en inmediaciones de Los Termales, 2500 m, 22 Jun 2003, *D. Giraldo-Cañas 3526* (COL); Mun. Villa de Leyva, camino entre la hacienda "Torcoroma de Arriba" y el cañón de Las Clusias, 2500 m, 18 Jul 2003, *D. Giraldo-Cañas 3553* (COL); Mun. Tunja, campus de la Universidad Pedagógica y Tecnológica de Colombia, 2700 m, 12 Nov 2003, *D. Giraldo-Cañas 3609* (COL). **Cauca:** Mun. Popayán, predios internos y jardineras abandonadas de la Facultad de Educación de la Universidad del Cauca, 1750 m, 7–11 Nov 2004, *D. Giraldo-Cañas 3810* (CAUP, COL); Popayán, airport, 1750 m, 2 Nov 1955, *A. Semple 59* (US); Mun. Coconuco, 2500 m, Jun 1948, *S. Yepes-Agredo 351* (COL, US). **Cundinamarca:** Mun. Choachí, carretera Choachí-Termales de Choachí, km 2, *ca.* 1600 m, 12 Nov 2001, *D. Giraldo-Cañas 3288* (COL); Mun. Soacha, autopista sur hacia Sibaté, km 17, en frente de la empresa Pisos Alfa, 2700 m, 3 Nov 2002, *D. Giraldo-Cañas 3312* (CAUP, COL); Mun. Nemocón, carretera entre la vereda Susatá y Nemocón, hacienda Susatá, 2700 m, 4 Nov 2002, *D. Giraldo-Cañas 3317* (COL, HUA); Provincia de Río Negro, Mun. Pacho, carretera Pacho-La Capilla, alrededores del estadio municipal de fútbol, 1600 m, 13 Jan 2004, *D. Giraldo-Cañas 3733* (COL); Mun. Suesca, hacienda Susatá, 2650 m, 10 Jul 2004, *J. Groenendijk 1813* (COL). **Huila:** Mun. Pitalito, en grietas de andenes del casco urbano, 1550 m, 1–5 Jul 2005, *D. Giraldo-Cañas et al. 3930* (COL, HUA). **Nariño:** Empatí, 1500–2000 m, 30 Apr 1939, *A.H.G. Alston 8297* (US); 5 km S of Tangua, 14 Jan 1963, *H.B. Cunningham 25* (US); Carretera Pasto-Túquerres, 2600 m, 30 Nov 1962, *C. Saravia 1812* (COL). **Quindío:** Mun. Calarcá, entrada del jardín botánico del Quindío, 1500 m, 20–25 May 2005, *D. Giraldo-Cañas 3894* (COL). **Santander:** Mun. Vélez, inmediaciones de la Feria de Ganado, 1700 m, 21 Jul 2003, *D. Giraldo-Cañas 3566* (COL). **Tolima:** Cordillerra Central andina, Mun. Ibagué, jardineras y andenes de la Plaza de Bolívar, ca. 1200 m, 11–12 Jun 2005, *D. Giraldo-Cañas et al. 3904, 3908* (COL). **Valle del Cauca:** Calima Valley, NW of Restrepo, 1500 m, 6 Jul 1962, *A.R. Bridgeman 50* (US); Palmira, Plana del Valle, predios de la Facultad de Agronomía de Palmira, 1000 m, 15 Jan 1964, *López Filgueiras 8498* (US); Mun. Yumbo, finca Río Grande, 1180 m, 12 Jun 1998, *D. Stancik 797* (COL). **Vichada:** Caño Urimica, 250 m, 19 Dec 1971, *I. Cabrera 1681* (COL).

25. Eragrostis viscosa (Retz.) Trin., Mem. Acad. Imp. Sci. St. Petersbourg Hist. Acad. 1:397 1830. (**Fig. 5, H**). *Poa viscosa* Retz., Obs. Bot. 4:20 (1786). Type: INDIA: Malabar, *König s.n.* (holotype: LD; isotype: BM!).

Tufted annuals. Culms 13–50 cm tall, erect, sometimes spreading or geniculate at the lower nodes, viscid below the nodes with a complete or partial ring of yellow glandular areas below the nodes. Leaf sheaths 1/2 the length of the internodes to overlapping, viscid, ciliate at the summit, collar, and along margins of the upper portion, the hairs up to 4 mm long, stiff; ligules 0.2–0.5 mm long; blades 4–15 cm long, 2–4 mm wide, flat, mostly glabrous with scattered papillose-based hairs, the hairs up to 4 mm long, the upper surface often viscid and covered with adherent soil particles. Panicle 6–22 cm long, 2–9 cm wide, open, cylindrical to ovate-lanceolate; ascending branches 0.5–6.5 cm long, spreading 20–90° from the rachises, viscid; pulvini in the axils of the primary branches sparsely ciliate or glabrous; pedicels 0.5–5 mm long, erect. Spikelets (2–)2.5–5.5 mm long, 1.2–2.2 mm wide, 5–9-flowered, ovate, compressed, reddish-purple to greenish-yellow, rachilla viscid; disarticulation between the florets with a portion of the rachilla; glumes 0.8–1.5 mm long, ovate to broadly ovate, hyaline to sub-hyaline, keeled, the nerve commonly green, scaberulous along the keel; lower glumes 0.8–1.3 mm long; upper glumes 1–1.5 mm long; lemmas 1.1–1.8 mm long, ovate the broadly oblong, membranous, lateral nerves evident, sometimes greenish, keeled, scaberulous along the keel; apex truncate to obtuse; paleas 1.1–1.8 mm long, bowed out, hyaline, pectinate-ciliate along the keels, the hairs 0.3–0.6 mm long; apex obtuse to truncate; stamens 3, anthers 0.2–0.4 mm long, purplish. Caryopses 0.4–0.5 mm long, ellipsoid, translucent, light brown. Chromosome number $2n = 40, 60$.

Distribution and habitat.—This species is distributed from México to Northern South America (Ecuador, and Venezuela); and is found in disturbed areas near cultivated fields, roadsides, and along river banks; 0–2000 m.

Specimens examined. **COLOMBIA. La Guajira:** Near Riohacha, 30 m, 30 Nov 1944, *O. Haught 4464* (COL, US); 4 km de Uribia rumbo a Maicao, 29 Mar 1962, *C. Saravia & D. Johnson 328* (COL, US). **Magdalena:** Hoya del río Cesar, hoya del río Azucarbuena, región El Callao, hacienda Santa Marta, 200 m, 29–30 Oct 1959, *J. Cuatrecasas & R. Romero-Castañeda 24962* (COL, US); Valle del río Cesar, entre Vallito y Mata de Indio, 60 m, 12 Feb 1961, *A. Dugand 5595* (COL). **Norte de Santander:** Los Estoraques, La Playa, 14 Jan 1974, *M.J. Balick 132* (COL); Carretera Cúcuta-Pamplona, La Esperanza, 1400 m, 19 Nov 1949, *H. García-Barriga 13259* (COL). **Valle del Cauca:** Cordillera Occidental, Yanaconas al Silencio, montaña La Victoria, 1700–2000 m, 5–10 Dec 1962, *H. García-Barriga 17610* (COL).

EXCLUDED SPECIES

Eragrostis patula (Kunth) Steud. (= *Poa patula* Kunth). This species is commonly referred to the Colombian Flora in local treatments, but the Colombian specimens belong to *Eragrostis tenuifolia* (pers. obs.). The recent use of this name in Bolivia (Renvoize 1998), and Ecuador (Jørgensen & León-Yánez 1999), places this as a synonym of *E. tenuifolia*. However, after studying the type at P and fragment at US, we are sure that this taxon is not a synonym of *E. tenuifolia*. Therefore, we are not including this name in this treatment.

Eragrostis unioloides (Retz.) Nees ex Steud. (= *Poa unioloides* Retz.). This species has been cited for the Antioquia´s Flora (www.mobot.org/tropicos) on based specimen *R. Callejas & A. Echeverri 11494* (MO!), but this collection belongs to *Poidium juergensii* (Hack.) Matthei.

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BOUTELOUA (POACEAE: CHLORIDOIDEAE: CYNODONTEAE: BOUTELOUINAE) DEL NORESTE DE MÉXICO

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RESUMEN

Se presenta el estudio taxonómico de *Bouteloua* para el noreste de México (Coahuila, Nuevo León y Tamaulipas). En el área de estudio se reconocen en total 25 especies nativas y tres variedades no típicas. Se describe y se ilustra **Bouteloua tamaulipensis** G.J. Pierce ex D. Pacheco y Columbus, sp. nov. Los nombres, *Atheropogon acuminatus* E. Fourn., *Bouteloua burkii* Scribn. ex S. Watson, *Chondrosium drummondii* E. Fourn., *Chondrosium foeneum* Torr. y *Chondrosium subscorpioides* Müll Hal., son lectotipificados. Se incluye una clave para determinar las especies, así como descripciones, mapas de distribución, especimenes examinados y sinonimia para cada especie de *Bouteloua* en el noreste de México.

ABSTRACT

A taxonomic treatment of *Bouteloua* for northeastern México (Coahuila, Nuevo León, and Tamaulipas) is given. A total of 25 native species and three nontypical varieties are recognized in the study area. **Bouteloua tamaulipensis** G.J. Pierce ex D. Pacheco & Columbus, sp. nov., is described and illustrated. The names, *Atheropogon acuminatus* E. Fourn., *Bouteloua burkii* Scribn. ex S. Watson, *Chondrosium drummondii* E. Fourn., *Chondrosium foeneum* Torr., and *Chondrosium subscorpioides* Müll Hal., are lectotypified. A key for determining the species, descriptions, distribution maps, specimens examined, and synonymies are presented for all species of *Bouteloua* in northeastern México.

Coahuila, Nuevo León y Tamaulipas o la región noreste de México cubre un área de 291,955 km^2 que corresponde al 15 % del área total de México (Fig. 1). La localización y nombre de cada Municipio en Coahuila, Nuevo León y Tamaulipas se presenta en las Figuras 2, 3 y 4. Esta región incluye porciones de dos regiones naturales conocidas como Desierto Chihuahuense y Desierto Tamaulipense. Estos desiertos son considerados como centro de origen y diversificación de especies de plantas de las zonas áridas y semi-áridas (Dávila-Aranda y col. 2004; Dávila y col. 2006; Espejo Serna y col. 2000; Peterson y col. 2001, 2007). Como parte de una revisión en curso, de la flora de gramíneas del noreste de México, para examinar la taxonomía y distribución de las especies de la subtribu Boutelouinae, fue iniciada en apoyo a las industrias agrícola y ganadera. En el presente estudio se tratan 25 especies y tres variedades no típicas.

La Subtribu Boutelouinae consta de un solo género, *Bouteloua*, con 57 especies (Columbus 1999; Columbus y col. 1998, 2000, 2007) con centro de origen en el suroeste de Estados Unidos y México, e incluye la gramínea dominante de los pastizales americanos *B. gracilis* (Kunth) Lag. ex Griffiths (navajita azul, zacate navajita).

La subtribu se caracteriza por presentar una inflorescencia de 1–muchas ramificaciones primarias espigadas distribuidas a lo largo del eje principal, los ejes de las ramificaciones persisten o caen enteros (Allred 1982), espiguillas bisexuales o unisexuales (plantas monoicas o dioicas), o estériles, solitarias, pareadas, o

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Fig. 1. Localización de Coahuila, Nuevo León y Tamaulipas en México.

en tripletes, algunas veces la segunda gluma biseriada, aristada o sin arista, lemas 3-nervadas, aristadas o sin arista, número básico de cromosomas $x = 10$, y con preferencia por los hábitats xéricos.

Como se ha entendido corrientemente para la Subfamilia *Chloridoideae* del Nuevo Mundo, las tribus Cynodonteae y Zoysieae son hermanas, uniéndose con este clade los miembros de la tribu Eragrostideae (Columbus y col. 2007; Peterson y col. 2007). Todas las tribus del árbol se apoyan en datos de secuenciación del ADN de cloroplastos (región matK, trnL-F) y genoma nuclear (ITS) (Hilu y Alice 2000, 2001; Columbus y col. 2007). Las relaciones entre las diez subtribus (*Boutelouinae* es una de ellas) dentro de Cynodonteae, así como los 25 géneros no colocados, son inciertas dependiendo de estudios adicionales. En este punto los agrostólogos no tienen idea clara de cómo son las relaciones entre estas diez subtribus Cynodonteae (Columbus y col. 2007; Peterson y col. 2007). Sin embargo, hay un buen sustento molecular para mantener la tribu Cynodonteae y uno morfológico para todas las diez subtribus.

Otros tratamientos taxonómicos importantes sobre *Bouteloua* que se consultaron para esta revisión incluyen Griffiths (1912), Gould (1979), Reeder y Reeder (1980), McVaugh (1983), Beetle (1987), Herrera Arrieta y Rzedowski (1990), Pohl (1994), Pacheco (2002), Wipff (2003) y Herrera Arrieta y col. (2004).

El siguiente tratamiento taxonómico contiene una clave para determinar las especies, descripciones, mapas de distribución, especimenes examinados y sinonimias. Este estudio está basado en el examen de especimenes de los herbarios: ANSM, ARIZ, B, BA, BAA, BM, CIDIIR, ENCB, GH, HINT (herbario personal de George S. Hinton), IBUG, INEGI, K, LE, MEXU, MICH, MO, MSC, NMC, NMSU, NY, P, RSA, SI, SLPM, TAES, TEX, UAT, US, UT, UTC, VT y W; incluyendo los especimenes tipo de la mayoría de las especies estudiadas.

Bouteloua Lag., Varied. Ci. 2(4, 21):134. 1805. Type: *Bouteloua racemosa* Lag.

Plantas anuales o perennes, cespitosas, estoloníferas o rizomatosas. Lígula membranácea, ciliada. Láminas

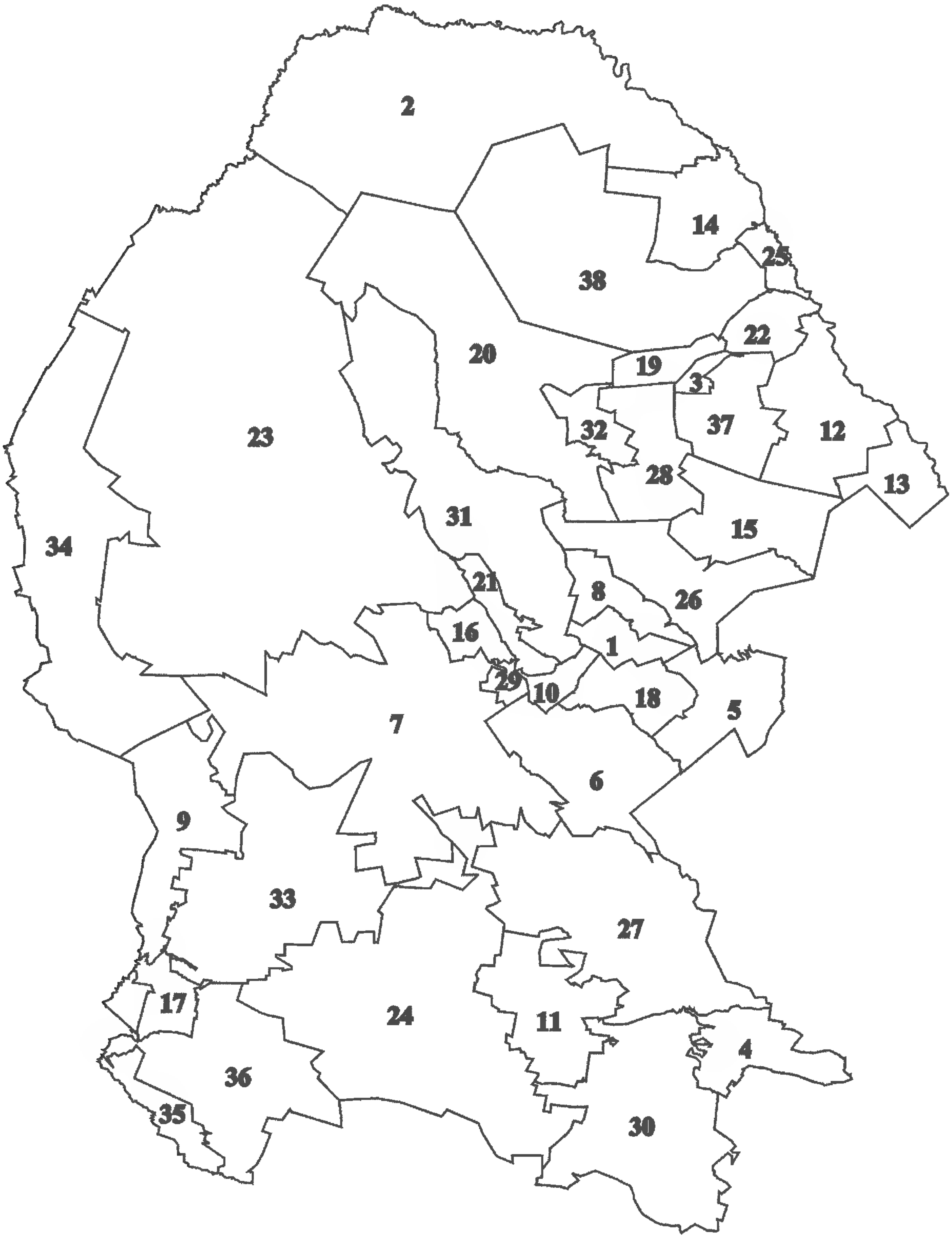

Fig. 2. Municipios en Coahuila: Abasolo-1, Acuña-2, Allende-3, Arteaga-4, Candela-5, Castaños-6, Cuatrociénegas-7, Escobedo-8, Francisco I. Madero-9, Frontera-10, General Cepeda-11, Guerrero-12, Hidalgo-13, Jiménez-14, Juárez-15, Lamadrid-16, Matamoros-17, Monclava-18, Morelos-19, Múzquiz-20, Nadadores-21, Nava-22, Ocampo-23, Parras-24, Piedras Negras-25, Progreso-26, Ramos Arizpe-27, Sabinas-28, Sacramento-29, Saltillo-30, San Buenaventura-31, San Juan de Sabinas-32, San Pedro-33, Sierra Mojada-34, Torreón-35, Viesca-36, Villa Unión-37 y Zaragoza-38.

foliares lineares, aplanadas o conduplicadas. Inflorescencia del subgénero *Chondrosum*: una a varias ramificaciones primarias espigadas racemosas unilaterales; raquis de la ramificación persistente; espiguillas numerosas, sésiles, pectinadas. Inflorescencia del subgénero *Bouteloua*: un racimo de 1 a numerosas ramificaciones primarias espigadas cortas, unilaterales; ramificaciones desarticulándose como una unidad y las espiguillas a veces también desarticulándose arriba de las glumas. Ramificaciones primarias espigadas por lo general con 3 a numerosas espiguillas, insertas en 2 hileras a lo largo del lado inferior del raquis. Espiguillas comprimidas lateralmente, con un flósculo perfecto y 1 a 2 flósculos rudimentarios, estaminados o

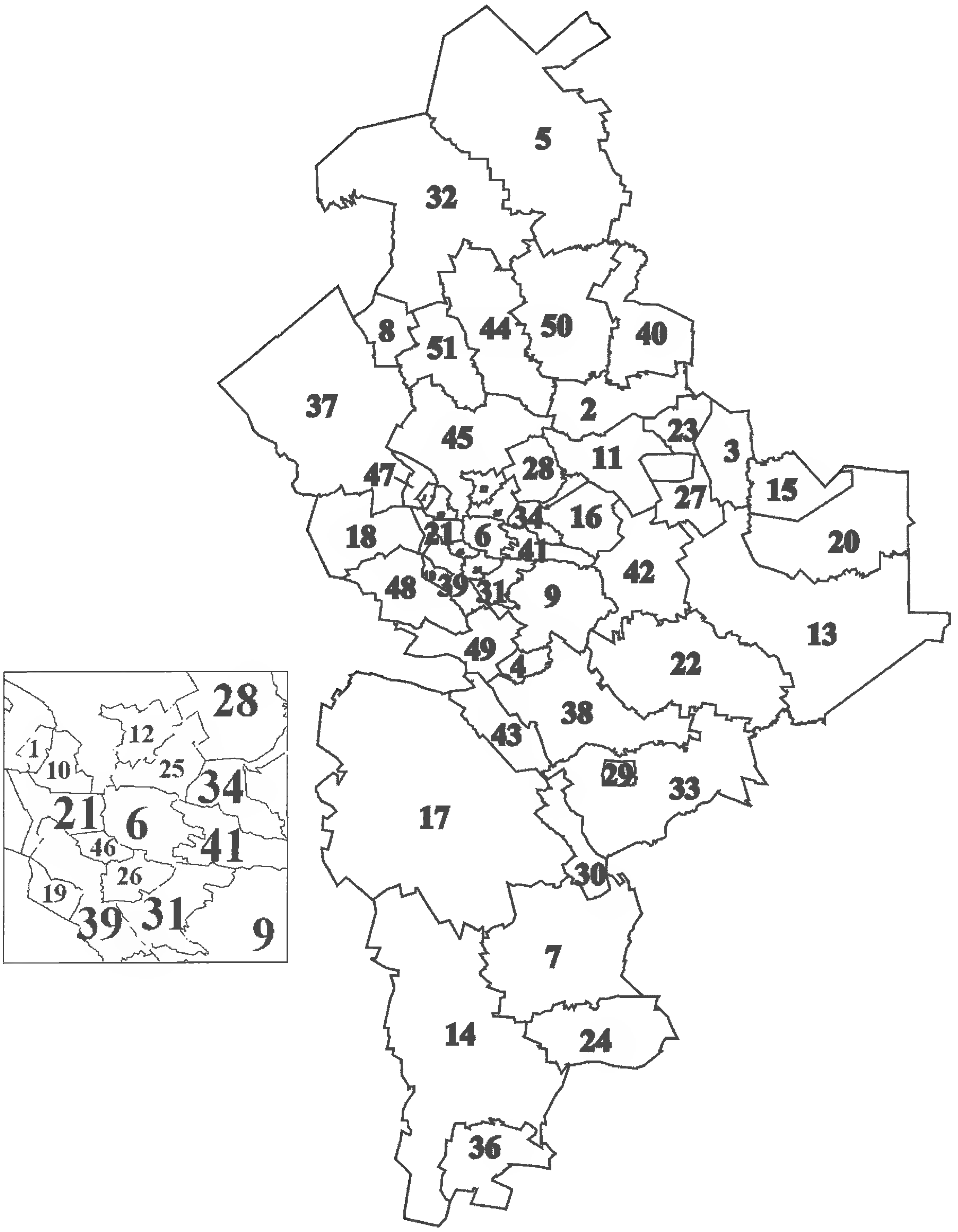

Fig. 3. Municipios en Nuevo León: Abasolo-1, Agualeguas-2, Aldamas Los-3, Allende-4, Anáhuac-5, Apodaca-6, Aramberri-7, Bustamante-8, Cadereyta Jiménez-9, El Carmen-10, Cerralvo-11, Ciénega de Flores-12, China-13, Doctor Arroyo-14, Doctor Coss-15, Doctor González-16, Galeana-17, García-18, San Pedro Garza García-19, General Bravo-20, Iturbide-30, General Escobedo-21, General Terán-22, General Treviño-23, General Zaragoza-24, General Zuazua-25, Guadalupe-26, Los Herreras-27, Higueras-28, Hualahuises-29, Juárez-31, Lampazos de Naranjo-32, Linares-33, Marín-34, Melchor Ocampo-35, Mier y Noriega-36, Mina-37, Montemorelos-38, Monterrey-39, Parás-40, Pesquería-41, Los Ramones-42, Rayones-43, Sabinas Hidalgo-44, Salinas Victoria-45, San Nicolás de los Garza-46, Hidalgo-47, Santa Catarina-48, Santiago-49, Vallecillo-50 y Villaldama-51.

estériles, modificados u ornamentados de forma variable. Glumas desiguales a subiguales, más cortas que la lema, 1-nervada, la primera más corta que la segunda. Lema del flósculo fértil cartilaginoso, 3-nervada, las nervaduras a menudo excurrentes como aristas. Pálea 2-carinada, el ápice 2-dentado o 2-mucronado. Lema del flósculo rudimentario generalmente reducida, con aristas alargadas. Lodículas 2, estambres 3, estilos 2. Fruto una cariopsis; embrión ½ a 2/3 partes la largo de la cariopsis; hilo punteado. En el área de estudio están presentes 25 especies.

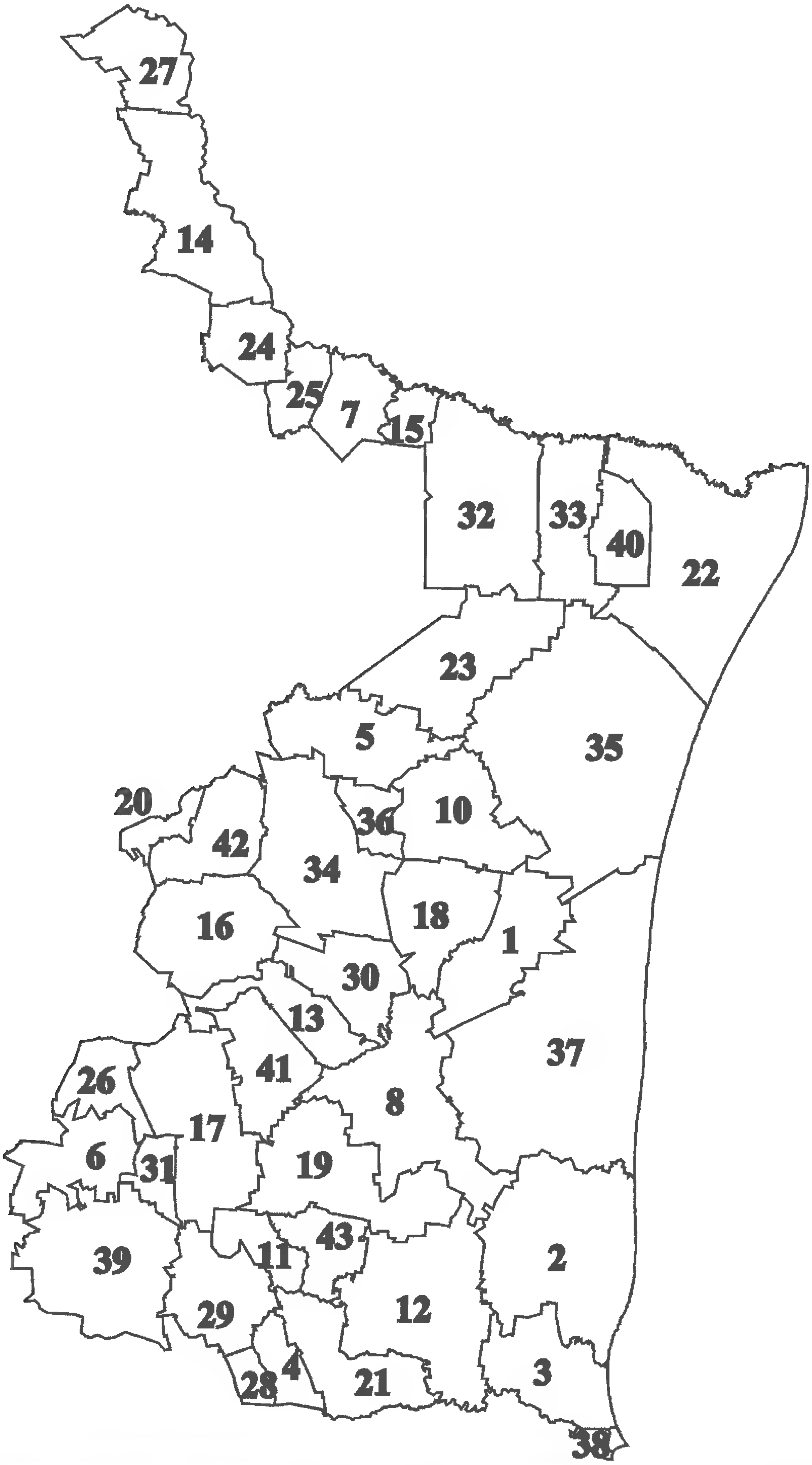
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Fig. 4. Municipios en Tamaulipas: Abasolo-1, Aldama-2, Altamira-3, Antiguo Morelos-4, Burgos-5, Bustamante-6, Camargo-7, Casas-8, Ciudad Madero-9, Cruillas-10, Gómez Farías-11, González-12, Güemez-13, Guerrero-14, Gustavo Díaz Ordaz-15, Hidalgo-16, Jaumave-17, Jiménez-18, Llera-19, Mainero-20, El Mante-21, Matamoros-22, Méndez-23, Mier-24, Miguel Alemán-25, Miquihuana-26, Nuevo Laredo-27, Nuevo Morelos-28, Ocampo-29, Padilla-30, Palmillas-31, Reynosa-32, Río Bravo-33, San Carlos-34, San Fernando-35, San Nicolás-36, Soto la Marina-37, Tampico-38, Tula-39, Valle Hermoso-40, Victoria-41, Villagrán-42 y Xicoténcatl-43.

CLAVE PARA SEPARAR LAS ESPECIES

1. Plantas dioicas o monoicas, espigas pistiladas diferentes en forma y tamaño a las estaminadas; inflorescencia femenina globular con 3 a 5 espiguillas que se desarticulan completamente; espiguillas femeninas unifloras; espiguillas masculinas 2-floras (*Buchloe*) _____ **6. B. dactyloides**
1. Plantas con flores perfectas, al menos las principales.
  2. Espiguillas 3 en cada espiga; la espiguilla central corto estipitada, 3-flosculares, primer flósculo hermafrodita, los laterales masculinos (*Cathestecum*).
    3. Entrenudos de los estolones usualmente de 15 cm o más largos; ramas de la inflorescencia mayores de 6 mm de largo; anteras 1.5 mm o más largas _____ **7. B. erecta**
    3. Entrenudos de los estolones menores de 15 cm; ramas de la inflorescencia de 6 mm o más cortas; anteras usualmente menores de 1.5 mm _____ **22. B. tamaulipensis**
  2. Espiguillas (1–)2 a varias en cada espiga, de diferente manera, con 1 a 2(–3) rudimentos, a veces representados por una arista.
    4. Espigas caedizas en la madurez, portando 1 a 12 espiguillas; las espiguillas permanecen insertas a las espigas.
      5. Ramas de la inflorescencia (espigas), la mayoría, con una sola espiguilla.
        6. Espigas pediceladas, con un pedicelo conspicuo de 2 a 3 mm de largo; plantas con estolones aéreos bien desarrollados; arista central del flósculo rudimentario (3.5–)4 a 4.5 mm de largo _____ **15. B. pedicellata**
        6. Espigas sésiles o con un pedicelo inconspicuo, menor de 0.5 mm de largo; plantas sin estolones aéreos desarrollados; arista central del flósculo rudimentario 2 a 3.5 mm de largo _____ **24. B. uniflora**
      5. Ramas de la inflorescencia (espigas) con (1–)2 a 12 espiguillas.
        7. Espigas (4–)9 a 80 por inflorescencia, inclinadas o péndulas, si son menos que 15, entonces las espigas miden menos de 1 cm.
          8. Espigas 9 a 25(–35), de 5 a 10 mm de largo, portando (1–)2 a 6 espiguillas; arista central del flósculo rudimentario 2.5 a 5 mm de largo _____ **25. B. warnockii**
          8. Espigas (4–)30 a 80, de 1 a 3 cm de largo, portando 2 a 7 espiguillas; arista central del flósculo rudimentario 5 a 10 mm de largo _____ **5. B. curtipendula**
        7. Espigas 1 a 16 por inflorescencia, erectas, ascendentes o patentes, de 0.7 a 4 cm de largo, si llegan a ser 20 entonces miden más de 1 cm.
          9. Plantas anuales; flósculo rudimentario típicamente reducido a una columna cilíndrica, aristada con 3 aristas iguales a subiguales; espiguillas aplicadas al raquis de la espiga, ampliamente separadas una de otra _____ **1. B. aristidoides**
          9. Plantas perennes; flósculo rudimentario bien desarrollado, estaminado o neutro; espiguillas aplicadas o extendidas desde el raquis de la espiga, escasamente separadas una de otra.
            10. Espigas portando (2–)3 a 5 espiguillas; segunda gluma híspida _____ **19. B. rigidiseta**
            10. Espigas portando 5 a 12 espiguillas; segunda gluma generalmente glabra.
              11. Láminas foliares involutas a todo lo largo, con el ápice rígido como espina, abundante lanoso-pubescentes en la superficie adaxial _____ **12. B. johnstonii**
              11. Láminas foliares aplanadas al menos en la mitad basal, la mitad distal llega a ser involuta cuando seca, el ápice nunca rígido como espina, glabras, hirsutas o con pelos de base papilosa en una o ambas superficies.
                12. Espigas 3 a 8, de 7 a 10 mm de largo; raquis de las espigas y segunda gluma híspidas en el dorso _____ **4. B. chondrosioides**
                12. Espigas 5 a 12, de 15 a 50(–70) mm de largo; raquis de las espigas y segunda gluma glabras a escabrosas.
                  13. Plantas con rizomas bien desarrollados, fuertes y escamosos, con entrenudos de 1 a 2 mm de largo; espiguillas 9 a 13 mm de largo _____ **16. B. radicosa**
                  13. Plantas sin rizomas, los entrenudos en la base de los culmos mayores de 2 mm; espiguillas 6 a 9 mm de largo _____ **18. B. repens**
    4. Espigas persistentes, portando (8–)20 a 60(–100) espiguillas; las espiguillas se desarticulan arriba de las glumas.
      14. Inflorescencia una sola espiga unilateral.
        15. Plantas claramente anuales _____ **21. B. simplex**
        15. Plantas perennes.
          16. Raquis de la espiga prolongada 2 a 10 mm más allá del punto de inserción de la espiguilla distal, terminando en una aguja semirígida; segunda gluma con pelos de base papilosa, al menos en algunas espiguillas _____ **11. B. hirsuta**

16. Raquis de la espiga sin extenderse más allá del punto de inserción de la espiguilla terminal; segunda gluma glabra o pubescente pero sin pelos de base papilosa.
17. Una sola espiga por culmo; raquis de la espiga y segunda gluma glabros a escabrosos; raquis claramente arqueado **20. B. scorpioides**
17. Una o más espigas por culmo; raquis de la espiga y segunda gluma pilosos o híspidos, a menudo piloso-papilosos; raquis recto, no arqueado **10. B. gracilis**
14. Inflorescencia con 2 o más espigas unilaterales.
18. Segunda gluma (al menos de algunas espiguillas) híspida o hirsuta con pelos de base papilosa.
19. Raquis de la espiga extendiéndose más adelante del punto de inserción de la espiguilla terminal **11. B. hirsuta**
19. Raquis de la espiga sin extenderse más adelante del punto de inserción de la espiguilla terminal.
20. Lema 3.5 a 4 mm de largo; espigas 3 a 8, de 1 a 3 cm de largo; plantas cespitosas o estoloníferas, pero nunca rizomatosas **14. B. parryi**
20. Lema 4 a 5.5 mm de largo; espigas (1–)2(–4), de (1.5–)3 a 4.5 cm de largo; plantas generalmente rizomatosas **10. B. gracilis**
18. Segunda gluma glabra o pubescente pero los pelos nunca de base papilosa.
21. Entrenudos del culmo, al menos los inferiores, lanoso-pubescentes.
22. Primera gluma 3 a 4 mm de largo, segunda gluma glabra; lema de la flor perfecta de 6 a 7 mm de largo, claramente glabra **8. B. eriopoda**
22. Primera gluma 2 a 3 mm de largo, segunda gluma vilosa a lanoso-pubescente; lema de la flor perfecta 5 a 6 mm de largo, esparcidamente pubescente sobre los nervios y barbada en la base **9. B. eriostachya**
21. Entrenudos del culmo completamente glabros.
23. Plantas anuales o perennes con ciclo de vida corto **2. B. barbata**
23. Plantas claramente perennes.
24. Inflorescencia con (1–)2(–4) espigas.
25. Culmos conspicuamente ramificados en la mitad inferior, barbados en las axilas de las ramas, con 4 a 5 nudos; segunda gluma 3 a 3.2 mm de largo, con un mucrón de 0.8 a 1 mm de largo; base de la planta firme y relativamente leñosa **17. B. ramosa**
25. Culmos nunca ramificados, con 1 a 2(–3) nudos, glabros; segunda gluma 5 a 6.5 mm de largo, apiculada, no mucronada; base de la planta firme pero nunca leñosa **10. B. gracilis**
24. Inflorescencia con 3 a 30 espigas.
26. Plantas de base fuertemente rizomatosa a subrizomatosa.
27. Espiguillas de 5 a 9 mm de largo; plantas de base subrizomatosa.
28. Culmos de 10 a 30(–40) cm de alto; espigas con 8 a 24(–32) espiguillas; segunda gluma glabra **23. B. trifida**
28. Culmos de 20 a 70 cm de alto; espigas con 40 a 100 espiguillas; segunda gluma esparcido pilosa a híspida **10. B. gracilis**
27. Espiguillas de 3 a 4.5 mm de largo; plantas de base fuertemente rizomatosa.
29. Segunda gluma 3 a 3.5 mm de largo; lema de la flor perfecta 4 a 4.5 mm de largo, densamente plateado pubescente; raquilla con un mechón denso de pelos en la base del flósculo rudimentario **3. B. chasei**
29. Segunda gluma 2 a 2.5 mm de largo; lema de la flor perfecta 2.5 a 3.2 mm de largo, esparcidamente pubescente; raquilla sin un mechón de pelos en la base del flósculo rudimentario **13. B. karwinskii**
26. Plantas de base nunca rizomatosa.
30. Lema de la flor perfecta glabra a esparcido estrigosa, con 3 aristas generalmente de 4 a 5(–6) mm de largo **23. B. trifida**
30. Lema de la flor perfecta pubescente en la base, con 3 aristas de 1 a 3 mm de largo **10. B. gracilis**

1. Bouteloua aristidoides (Kunth) Griseb. var. **aristidoides,** Fl. Brit. W.I. 537. 1864. (**Fig. 5**). *Dinebra aristidoides* Kunth, Nov. Gen. Sp. (quarto ed.) 1:171. 1816. *Atheropogon aristidioides* (Kunth) Roem. & Schult., Syst. Veg. 2:415. 1817. *Eutriana aristidoides* (Kunth) Trin., Gram. Unifl. Sesquifl. 242. 1824. *Triathera aristidoides* (Kunth) Nash, Fl. S.E. U.S. 137. 1903. Tipo: MÉXICO: Crescit in asperis frigidis convallis Tolucensis (cercano Nevado Toluca), Sep, *F. Humboldt & A. Bonpland 67* (holotipo: P; isotipo: US fragm.!).

Bouteloua ciliata Griseb., Abh. Königl. Ges. Wiss. Göttingen 24:302. 1879. Tipo: ARGENTINA. Salta: cerca del Pasaje del Río Juramento, 21 Feb 1873, *P.G. Lorentz & G. Hieronymus 352* (holotipo: GOET; isotipo: US-A865569 fragm. ex GOET!).

Dinebra hirsuta J. Presl., Reliq. Haenk. 1(4–5):292. 1830. *Eutriana hirsuta* (J. Presl) Kunth, Enum. Pl. 1:280. 1833. Tipo: PERÚ: *Haenke s.n.* (holotipo: PR; isotipo: US fragm.!).

Plantas anuales de vida corta, amacolladas. Culmos de 6 a 50 cm de alto, delgados, frágiles, simples, los laterales curveado-erectos desde una base decumbente. Follaje muy escaso; vainas más cortas que los entrenudos; lígula de 0.2 a 0.5 mm de largo, un anillo de pelos cortos; láminas foliares de 2 a 4 cm de largo y 1 a 2 mm de ancho, delgadas, aplanadas o conduplicadas, superficie adaxial a menudo con escasa pubescencia de pelos largos y duros en la base, que en ocasiones se extiende hacia el ápice. Inflorescencia de 2.5 a 10 cm de largo; ramificaciones primarias espigadas 6 a 16, de 1 a 2(–3.5) cm de largo, erectas o ascendentes, caedizas, espaciadas, abiertas, portando 2 a 5(–10) espiguillas; raquis aplanado, densamente pubescente por lo menos en la base, ápice curvado, extendiéndose (2–)6 a 10 mm más adelante de la inserción de la espiguilla terminal. Espiguillas de 6 a 8 mm de largo, permanecen insertas a las espigas, las inferiores de las ramas aplicadas al raquis, sin flósculo rudimentario, con la lema sin arista a corto aristada; las superiores de las ramas con un flósculo rudimentario reducido a una columna 3-aristada, de 2 a 6 mm de largo; glumas muy desiguales, angostas, agudas o acuminadas, primera gluma de 2 a 2.5 mm de largo, aristiforme, escabroso-puescente, segunda gluma de 6 a 7 mm de largo, ancha, esparcido pubescente principalmente sobre los márgenes, a menudo abierta formando un amplio ángulo con la flor; lema de la flor perfecta 6 a 7 mm de largo, con aristas cortas de 0.4 a 0.6 mm de largo, escaso a abundantemente pubescente sobre la nervadura media; pálea de 6 a 7 mm de largo, glabra. Flósculo rudimentario 1, lema de 8 a 10 mm de largo, fuertemente 3-aristada; aristas de 6 a 8 mm de largo, aplanadas, escabrosas. Anteras de 3 a 4 mm de largo. Cariopsis de 2 a 2.5 mm de largo, color amarillo cambiando a café en la madurez, lanceolado-elíptica. $2n = 40$. Florece probablemente durante la primavera.

Comentarios.—Se le reconocen dos variedades *B. aristidoides* var. *aristidoides* y *B. aristidoides* var. *arizonica*, esta última muy poco común.

Distribución.—Sw de Estados Unidos a México; Sudamérica en: Argentina, Bolivia, Brasil, Paraguay y Perú.

Hábitat.—Pastizales deteriorados, matorrales xerófilos, a orilla de cultivos y en lugares pedregosos y secos; 245 a 1900 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Coahuila, *E. Palmer 1353* (US); Municipio de Escobedo, 33.5 km al SE del ejido Paso de San Antonio, Rancho el Carrizal, 2 Oct 1972, 1150 m, *F. Chiang s.n., T. Wendt & M.C. Johnston* (MEXU); Municipio de Matamoros, 10 km carretera Matamoros-Saltillo, 5 Sep 1988, *J. Espinosa 88* (ANSM, TAES); Municipio de Muzquiz, Sierra del Carmen, Ejido San Francisco, 5 Sep 2005, 1424 m, *P.M. Peterson 18817, J. Valdés-Reyna & C. Sifuentes* (US); Municipio de Ocampo, Along the Río Grande, 1 km W of Boquillas de Carmen, 6 Sep 2005, 560 m, *P.M. Peterson 18870, J. Valdés-Reyna & C. Sifuentes* (US); Municipio de Parras, El Mesteño, Ejido 4 de Marzo, 29 Jul 1994, *F.A. Roing 94* (ANSM); Municipio de Saltillo, El Chiflón, carretera Saltillo-Torreón, *E. Lyonnet 3762* (MEXU); 10 km al NW de San Fernando y 2 km al N de Loma de Piojo, *H. García s.n.* (SLPM); Municipio de San Pedro, 5.5 km al NW de Nueva Delicias, vertiente E de la Sierra de las Delicias, al N de San Pedro de las Colonias, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1489* (CIIDIR, HUAA); Municipio de Torreón, 3 km de Torreón, Fracc. La Florida, 1120 m, *B. Rodríguez-C 4,9* (ANSM, COCA, IEB); Sierra de Jimulco, proximidades al ejido La Trinidad, 25 Aug 1988, 1900 m, *J.A. Villarreal 4414, M.A. Carranza & A. Rodríguez* (ANSM, MEXU); 13 Oct 1989, *E. Palmer 513* (MEXU); Municipio de Viesca, 5 km antes de Viesca, 25 Aug 1988, 1500 m, *J.A. Villarreal 4456, M.A. Carranza & A. Rodríguez* (ANSM, CIIDIR). **Tamaulipas:** Municipio de Casas, Camino al Ejido 1° de Abril, 28 Jul 1983, 245 m, *M.H. Cervera 153* (MEXU).

2. Bouteloua barbata Lag. var. **barbata,** Varied. Ci. 2(4):141. 1805. (**Fig. 6**). *Actinochloa barbata* (Lag.) Roem. & Schult., Syst. Veg. 2:420. 1817. *Eutriana barbata* (Lag.) Kunth, Revis. Gramin. 1:96. 1829. *Chondrosum barbatum* (Lag.) Clayton, Kew Bull. 37:417. 1982. Tipo: MÉXICO: *Nee s.n.* (holotipo: MA; isotipo: US-865567 fragm. ex MA!).

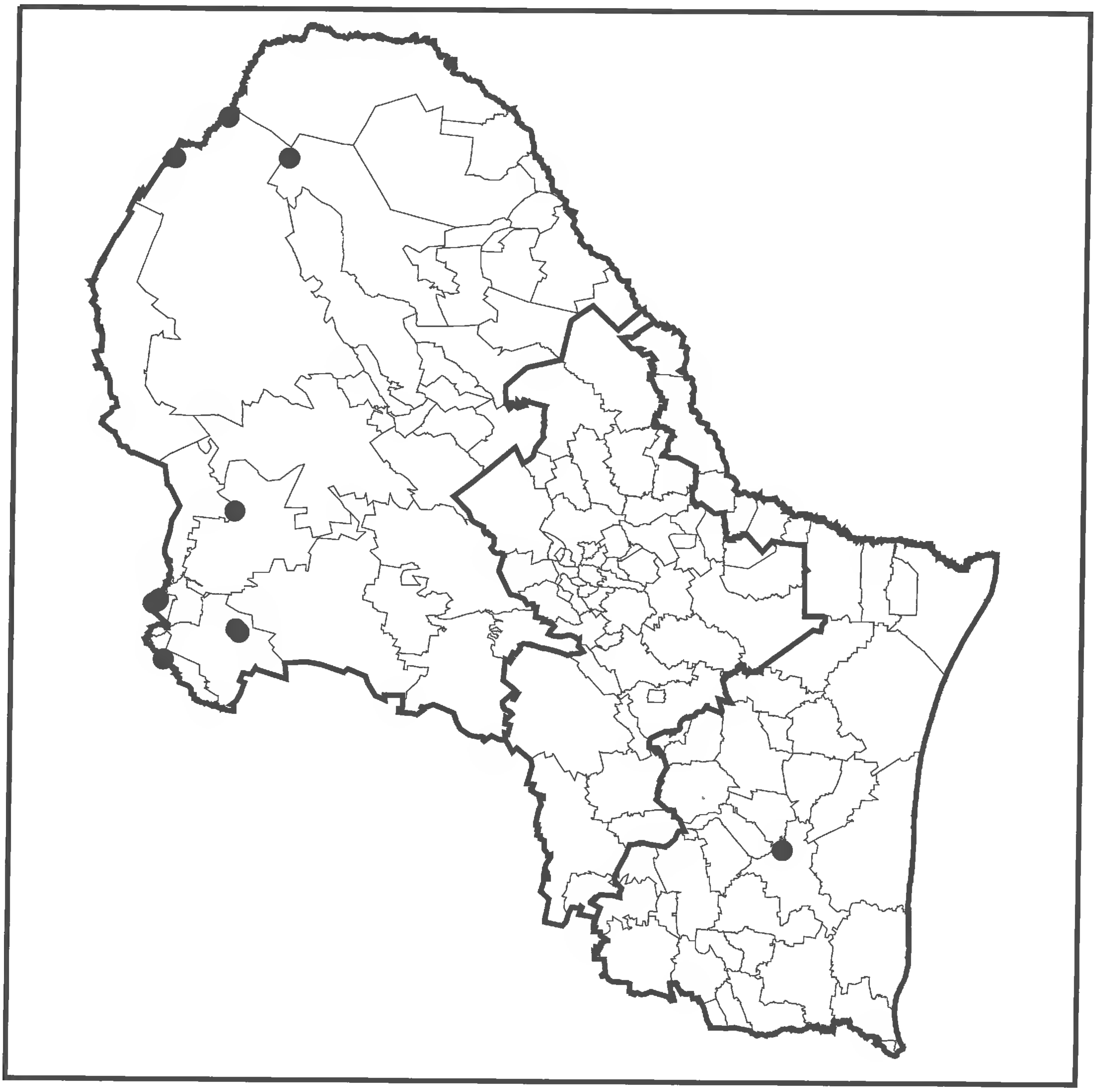


Fig.5. Distribución de *Bouteloua aristidoides* var. *aristidoides* en el noreste de México.

Chondrosium polystachyum Benth., Bot. Voy. Sulphur 56. 1844. *Bouteloua polystachya* (Benth.) Torr., Pacif. Railr. Rep. 5(2):366, t. 10. 1857. Tipo: MÉXICO. Baja California Sur: Bahía Magdalena, *G.W. Barclay s.n.* (holotipo: K; isotipos: BM, US-A865566 fragm. ex K!).

Chondrosium su bscorpioides Müll Hal., Bot. Zeitung (Berlin) 14:347. 1856. Tipo: MÉXICO. Baja California: Patria, *G.W. Barclay s.n.* (lectotype, designado aquí: US-883457 ex K!, un espécimen con etiquetado "lower California.").

Bouteloua pumila Buckley, Proc. Acad. Nat. Sci. Philadelphia 14:93. 1862. Tipo: U.S.A. New Mexico & Texas: *C. Wright 754* (lectotipo: PH, designado por Griffiths, Contr. U.S. Natl. Herb. 14(3) 383. 1912; isolectotipos: GH, US-81706!).

Chondrosium exile E. Fourn., Mexic. Pl. 2:137. 1886. Tipo: MÉXICO: *J.L. Berlandier 842* (holotipo: P; isotipos: US-A865678 fragm. ex P!, W).

Chondrosium microstachyum E. Fourn., Mexic. Pl. 2:138. 1886. *Bouteloua microstachya* (E. Fourn.) L.H. Dewey, Contr. U.S. Natl. Herb. 2(3):531. 1894. Tipo: MÉXICO: Guadelupe, 1865–1866, *M. Bourgeau 667* (holotipo: P; isotipos: LE, MO, US-74908!, US-87194 fragm.!).

Bouteloua arenosa Vasey, U.S.D.A. Div. Bot. Bull. 12(1): t. 34. 1890. *Bouteloua barbata* var. *arenosa* (Vasey) Beetle, Phytologia 54:1. 1983. Tipo: MÉXICO. Sonora: Guaymas on the Gulf of California, 1887, *E. Palmer 189* (holotipo: US-81716!).

Bouteloua micrantha Scribn. & Merr., Circ. Div. Agrostol. U.S.D.A. 32:8. 1901. 32:8. 1901. Tipo: U.S.A. Arizona: Pima Co.: Fort Lowell, Sep 1900, *D. Griffiths 1556* (holotipo: US-81724!).

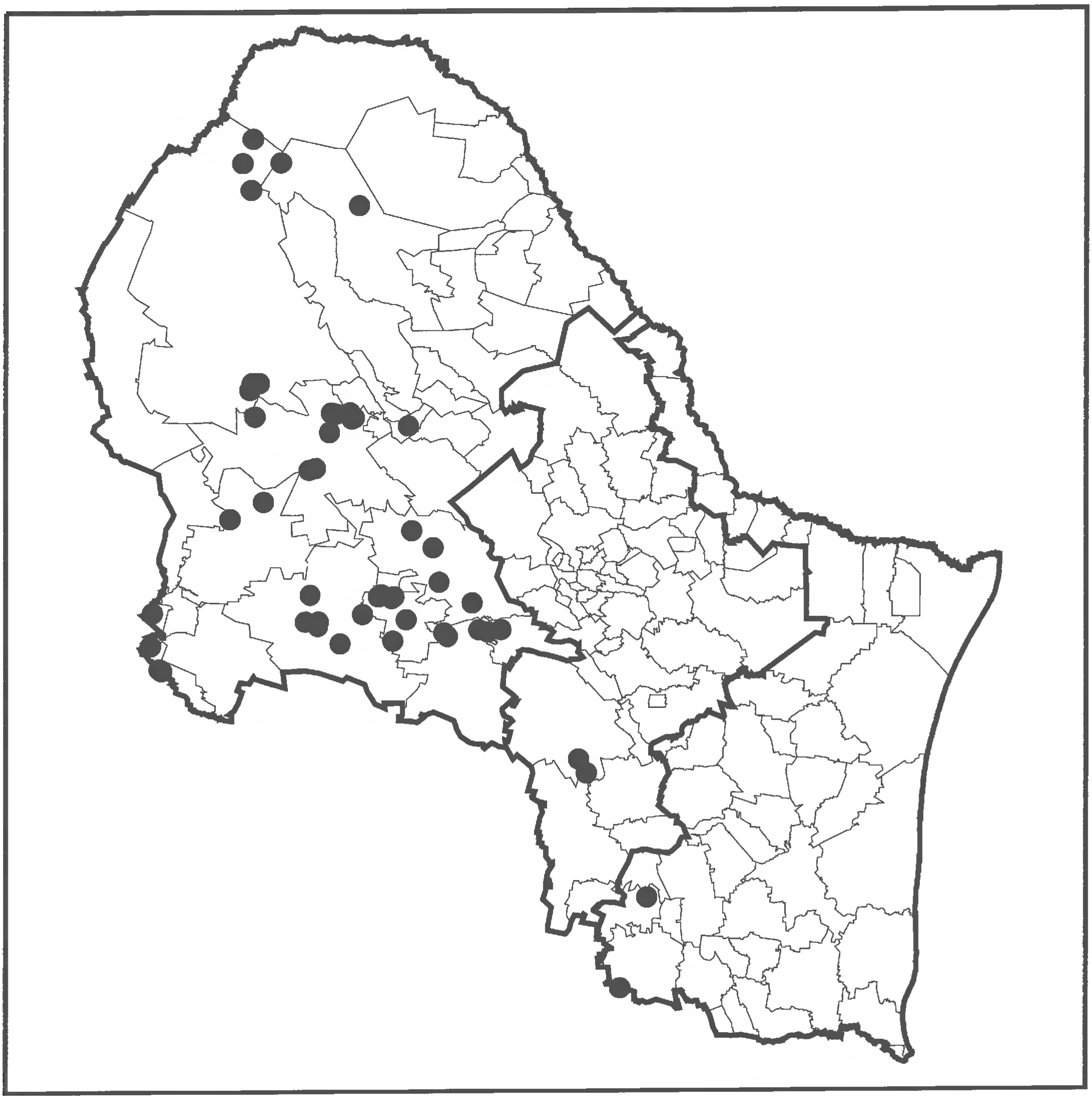


Fig. 6. Distribución de *Bouteloua barbata* var. *barbata* en el noreste de México.

Plantas anuales, de ciclo corto, de tamaño y aspecto variable, según hábitat y grado de desarrollo. Culmos de 5 a 30(–50) cm de alto, separados y decumbentes o amacollados y erguidos en vegetación densa, nunca desarrollando estolones; entrenudos sólidos, glabros. Hojas persistentes, caulinares y basales, de textura suave; vaina con el margen membranoso-hialino de 1 a 5 cm de largo; lígula de 0.6 a 1 mm de largo, un anillo de pelos cortos y largos, hialinos; láminas foliares de 1 a 9 cm de largo y 1 a 3 mm de ancho, aplanadas, rectas; escabrosas en la superficie adaxial, con pubescencia de base papilosa a los lados de la nervadura principal y en ocasiones en las nervaduras laterales; la superficie abaxial escabrosa, a veces con pelos hirsutos de base papilosa; ápice acuminado. Inflorescencia con (2–)7(–11) ramificaciones primarias espigadas por culmo; ramificaciones 1 a 2.5 cm de largo y 1.5 a 5 mm de ancho, persistentes, unilaterales, purpúreas, corto pediceladas, curvadas, portando 20 a 30(–45) espiguillas; raquis aplanado, escabroso. Espiguillas de 1 a 2.5 mm de largo, articulación por arriba de las glumas; glumas desiguales ovadolanceoladas, aquilladas, marginadas irregularmente, prolongándose en un mucrón corto, primera gluma de 0.7 a 1.5 mm de largo, color verde pálido a hialina, segunda gluma de 1.5 a 2.5 mm de largo, glabra, púrpura marginada; lema de 1.7 a 4 mm de largo, ligeramente pilosa en la base, con 3 aristas de 1.5 a 2 mm de largo, escabrosas, y 4 dientes intercalados con las aristas, color verde pálido; pálea de 1.5 a 4 mm de largo, color verde pálido, con 2 aristas escabrosas, porciones laterales pilosas en toda su superficie. Flósculo rudimentario 1, de 1.5 a 4 mm de largo incluyendo las aristas, con 3 aristas purpúreas, escabrosas, divergentes, de 0.8 a 4 mm de largo, y 3 lóbulos de 0.5 a 1 mm de largo, color verde claro con los márgenes púrpura; callo de 0.7 a 1 mm de largo, con un anillo piloso. Anteras de 1 a 1.2 mm de largo, color amarillo-rojizo. Cariopsis 0.5 a 1.3 mm de largo, angulosa-triangular. $2n = 20, 40$. Florece de agosto a diciembre.

Distribución.—Amplia en Estados Unidos y México, encontrada también en Argentina.

Hábitat.—Orilla de caminos, bordos, arroyos; áreas de cultivo, suelos arenosos, gravosos y arcillosos; matorrales desértico micrófilo, espinoso, subespinoso, y sarco-crasicaule; pie de monte; 650 a 1900 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Arteaga, Arroyo Canoas, 28 Jul 1993, 1600 m, *F. Alcalá 22-A* (MEXU); Arteaga, 18 Sep 1991, 1600 m, *Brigada Coahuila 229* (MEXU); Municipio de Cuatrociénegas, 2 millas NO de Cuatrociénegas, carretera a Ocampo, 22 Sep 1990, 830 m, *P.M. Peterson 9997, C.R. Annable y J. Valdés-Reyna* (ANSM, US); 28 mi SO de Cuatrociénegas, 23 Sep 1990, 750 m, *P.M. Peterson 10003, C.R. Annable & J. Valdés-Reyna* (ANSM, US); km 11 E de Cuatrociénegas, 24 Sep 1955, 650 m, *E. Hernandez-X. 2023, 2034, V. Mathus* (ANSM); 4 mi al E de Cuatrociénegas, *I.M. Johnston 7117* (US); Cerca de Rosario, W de Cuatrociénegas, *I.M. Johnston 8824* (US); Rancho La Zacatosa, camino de terracería, Cuatrociénegas-Sierra Mojada, 10 Sep 1991, 1180 m, *M.A. Carranza 997, L. García* (ANSM, CIIDIR); Sierra de la Madera, Cañón Charreteras, rancho Charreteras, 15 Sep 1993, 1750 m, *J.A. Villarreal 7359, M.A. Carranza & R. Rodríguez* (ANSM); Sierra de San Marcos, areas cercanas a la Poza de La Becerra, 25 Sep 1988, 950 m, *A. Zarate 2* (ANSM); Municipio de General Cepeda, 38 km O of Paila on highway 40, 21 Jun 1964, 1400 m, *G. Mick* 84, *K. Roe* (TAES); Paila junction on Mex 40, Parras, *J.M. Flook & J.D. Spears 75* (CHAPA); 41 mi O of Saltillo, 5 Sep 1965, 1400 m, *F.W. Gould 11536* (TAES, US); km 45 carr. 40 Saltillo-Torreón, en la desviación a Gral. Cepeda, *Y. Herrera Arrieta & A. Cortés 1477* (CIIDIR, HUAA); 10 km al W de Saltillo, carr. Saltillo-Gral. Cepeda, *J. Valdés-Reyna, L.E. Rodriguez & R. Vázquez 157126* (ANSM); Municipio de Monclava, 3 mi W de Monclava, 11 May 1979, desert grassland, 600 m, *F.W. Gould 15565 & R.B. Shaw* (CHAPA); Municipio de Muzquiz, Sierra del Carmen, Ejido San Francisco, 5 Sep 2005, 1430 m, *P.M. Peterson 18831, J. Valdés-Reyna & C. Sifuentes* (US); 7.2 mi SE of Jaboncillos on road towards Cuesta de malena and Melchor Muzquiz, 01 Sep 2006, 1010 m, *P.M. Peterson 19850, S. Lara-Contreras* (US); Municipio de Nava, Sierra El Jardín, slopes above Canyon del Diablo, 2 Sep 2006, 1418 m, *P.M. Peterson 19882, S. Lara-Contreras* (US); Municipio de Ocampo, Rancho el Barranquito, aprox. 50 km de Ocampc rumbo a Sierra Mojada, 2 Oct 1990, 1200 m, *M.A. Carranza 574, F.J. Carranza* (ANSM); Rancho Las Gallinas, aprox. 43 km de Ocampo rumbo a Sierra Mojada, 2 Oct 1990, 1300 m, *M.A. Carranza 565, F.J. Carranza* (ANSM); Sierra de la Madera, Rancho Laguna de la Leche, aprox. 62 km de Ocampo rumbo a Sierra Mojada, 2 Oct 1990, 1000 m, *M.A. Carranza 624, F.J. Carranza* (ANSM, TAES); Municipio de Parras, 2 km al O de Parras, 10 Sep 1960, *F. Medellín 987* (CHAPA, MEXU); El Mesteño, Ejido 4 de Marzo, 28 Jul 1976, 1290 m, *F.A Roing 99* (ANSM); km 82 carretera Torreón-Saltillo, 23 Sep 1955, 1000 m, *E. Hernández-X. 1997, V. Mathus* (ANSM, CHAPA, US); Sierra de Parras en el cañón de Gustrola, 10 Oct 1980, 1850 m, *A. Rodríguez 253, M.A. Carranza* (ANSM); Parras, *W.A. Archer 3405* (US); Municipio de Ramos Arizpe, Cañada el Diente, Sierra de la Paila, 19 Sep 1989, 1300 m, *J.A. Villarreal 5193, M.A. Carranza* (ANSM); La Sauceda, 17 Dic 1965, 1030 m, *G. Cano 65-6* (TAES); Rancho Santo Domingo, 5 Nov 1982, 1680 m, *F. Coss-V* (ANSM); Municipio de Saltillo, 26 km O de Saltillo, carretera Saltillo-General Cepeda, ejido La Noria, 21 Jul 1983, 1780 m, *J. Valdés-Reyna 1571, L.E. Rodríguez* (ANSM); About 3 mi E of San José, 18 Aug 1941, *I.M. Johnston 8216* (MEXU); 1898, *E. Palmer 400, 514* (MEXU); Municipio San Pedro, 5.5 km al NW de Nueva Delicias, vertiente E de la Sierra de las Delicias, al N de San Pedro de las Colonias, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1488* (CIIDIR, HUAA); San Pedro, Sierra de San Salvador, ladera, carretera San Pedro-Cuatrociénegas, 12 Ene1974, 900 m, *J.S. Marroquín s.n.* (ANSM); Municipio de Torreón, Plains near Jimulco, 24 Sep 1902, 1524 m, *C.G. Pringle 11216* (MEXU, TAES); Sierra de Jimulco, proximidades al ejido La Trinidad, 25 Aug 1988, 1900 m, *J.A. Villarreal 4413, M.A. Carranza & A. Rodríguez* (ANSM); Colonia Estrella, Torreón, *B. Rodríguez s.n.* (IEB, SLPM); *L.M. Villarreal 4105* (IBUG); 5 km al NE de las Lilas, *M.A. Carranza & L. García 7848* (IBUG); S of Torreon canyon between Jimulco and Juan Eugenio, *P.M. Peterson 8470, J. Valdés-Reyna* (US). **Nuevo León:** Municipio de Allende, 153.2 km NW of Muzquiz on Hwy 53 towards Boquilla del Carmen and 8 km NW of jct of road to Encantada, 12 Sep 1991, 1250 m, *P.M. Peterson 10605, C.R. Annable* (US); Municipio de Galeana, El Salero, 19 Sep 2001, 1840 m, *P.M. Peterson 15818, J. Valdés-Reyna* (US); 19 km SE of El Salero, 19 Sep 2003, 1707 m, *P.M. Peterson 17837, J. Valdés-Reyna & H.S. Hinton* (US). **Tamaulipas:** Municipio de Bustamante, Rumbo a la Cabecera de Bustamante, 4 Sep 1981, 1600 m, *J.G. Galván 31* (MEXU); Municipio de Miguel Alemán, Brecha de Pemex, 25 Oct 1991, 95 m, *C.R. López 202* (MEXU); Municipio de Tula, 40 km al S de Tula, 25 Aug 1983, *I. Nuñez 16* (MEXU).

3. Bouteloua chasei Swallen, Proc. Biol. Soc. Wash. 56:81. 1943. (**Fig. 7**). *Chondrosum chasei* (Swallen) Clayton, Kew Bull. 37:418. 1982. Tipo: MÉXICO. Nuevo León: Galeana, Mesa, 5400 ft, 30 Jul 1939, *A. Chase 7673 ½* (holotipo: US-1763078!).

Plantas perennes, amacolladas, rizomatosas. Culmos 15 a 30 (50) cm de alto, desde una base firme, nudosa; entrenudos glabros. Hojas basales; vainas más cortas que los entrenudos, con pubescencia diminuta cerca de los márgenes, barbados a los lados de la lígula; lígula de 3 mm de largo, un anillo de pelos; láminas foliares

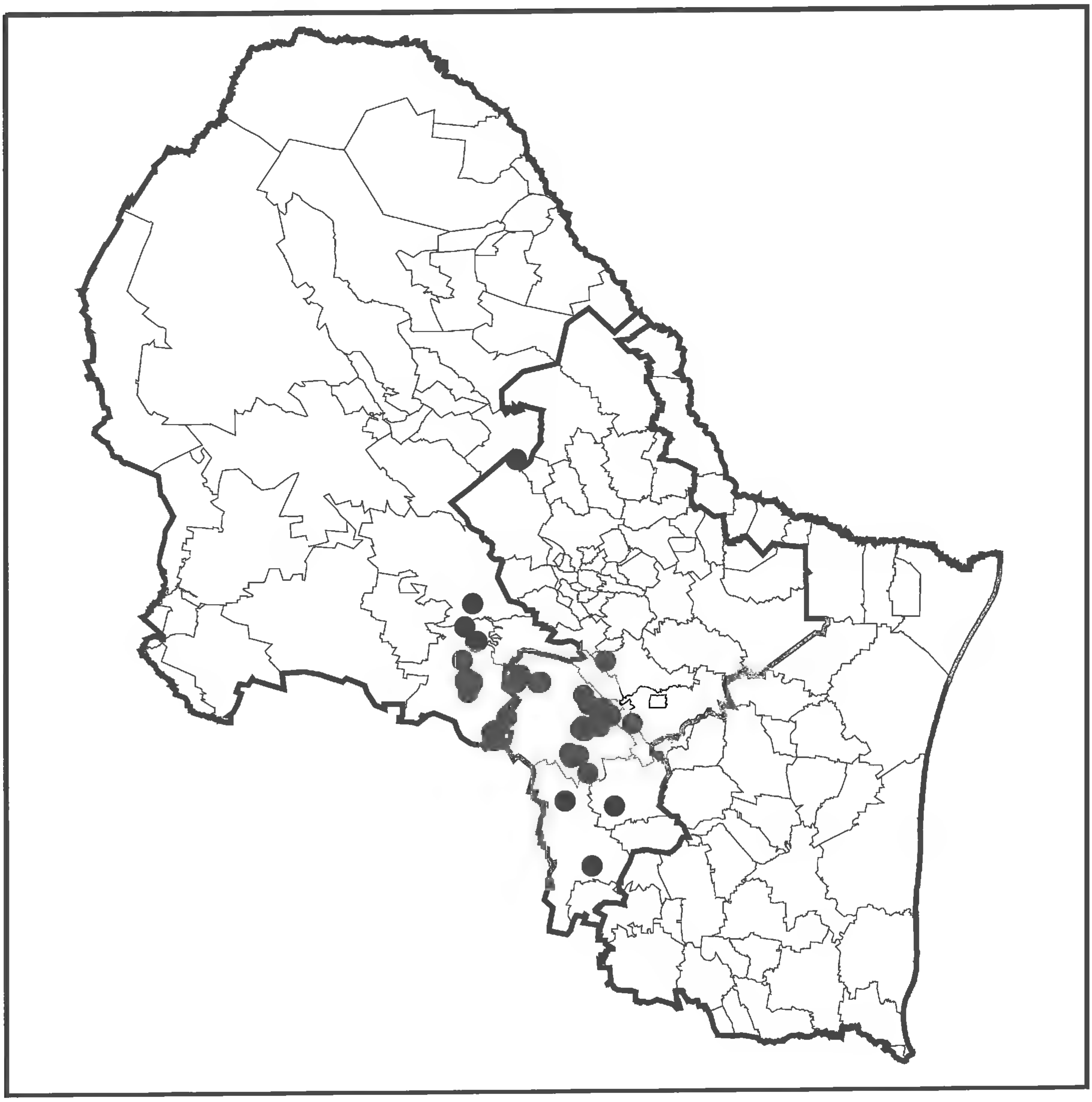


Fig. 7. Distribución de *Bouteloua chasei* en el noreste de México.

de 3 a 10 cm de largo y 2 a 3 mm de ancho, cerrado-involutas, angostas y fuertes, arqueadas, pungentes, esencialmente glabras. Inflorescencia de 2 a 4(–8) cm de largo, con 2 a 3(–5) ramificaciones primarias espigadas; ramificaciones de 1.5 a 2(–2.5) cm de largo, erectas o algo curvadas, persistentes, portando 18 a 25(–30) espiguillas; raquis glabro, en ocasiones con pelos cortos sobre el margen. Espiguillas de 3.5 a 4.5 mm de largo, articulación por arriba de las glumas; glumas desiguales, la primera de 1.5 a 2 mm de largo, la segunda de 3 a 3.5 mm de largo, mucronadas, pubescentes hacia el ápice y el nervio central; lema de la flor perfecta de 4 a 4.5 mm de largo, densamente plateado-pubescente, pelos aplicados, de 0.6 a 0.8 mm de largo, diminuto aristada desde un ápice bífido; arista de 2 a 3 mm de largo; pálea 3 mm de largo, pubescente hacia un ápice 2-dentado. Flósculos rudimentarios 2, con un mechón denso de pelos en la base de ambos flósculos rudimentarios, el primero de 3 a 4 mm de largo incluyendo la arista, el segundo de 1 a 1.5 mm de largo, truncado, sin aristas. Anteras de 1 a 1.5 mm de largo. Cariopsis de 1.8 a 2.2 mm de largo, color amarillo, lanceolado-elíptica. $2n = 40$. Florece de julio a diciembre.

Distribución.—Especie mexicana de: Coahuila, Durango, Nuevo León, San Luis Potosí y Zacatecas.

Hábitat.—Es un componente estricto de suelos yesosos y secos, asociado a plantas arbustivas; 1219 a 2150 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Ramos Arizpe, Rancho Santo Domingo, 10 Oct 1982, 1680 m, *F. Coss-V. s.n.* (ANSM); Municipio de Saltillo, 28.2 mi S de Saltillo, carretera 54 a Concepción del Oro, Zac., 24 Sep 1990, 1860 m, *P.M. Peterson 10030, C.R. Annable & J. Valdés-Reyna* (ANSM, US); 33 mi S de Saltillo, carretera 54, 17.7 mi E de La Ventura, 24 Sep 1990, 1720 m, *P.M. Peterson 10041, C.R. Annable & J. Valdés-Reyna* (ANSM, US); 53 km S of Saltillo, along hwy 54, S of Concepción del Oro, Zacatecas, 26 Aug 1981, 1850 m, *S.L. Hatch 4504, C.W. Morden & J. Valdés-Reyna* (ANSM); Along road to Concepcion del Oro, Zac., 35 Mi S of Saltillo, 5 Sep 1963, 1890 m, *J.R. Reeder 3621, C.G. Reeder.* (ENCB, MEXU); Buenavista, 7 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zacatecas, 9 Aug 1974, 1775 m, *J.F. Cano 111* (ANSM); 7 kmal S de la Cd. de Saltillo, *F. del Río s.n.* (ENCB); 7 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., Nov 1973, 1776 m, *M.A. González, s.n.*(ANSM); 7 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 28 Jul 1974, 1775 m, *R.E. Rodríguez s.n.* (ANSM); 40 km al SW de Saltillo rumbo a Zacatecas, en el km 295 de la carr. 54, *Y. Herrera Arrieta & A. Cortés 1457* (CIIDIR, HUAA); La Ventura, aprox. 80 km S de Saltillo, 10 Oct 1989, 1800 m, *J. Valdés-Reyna 1989, J.A. Villarreal & M.A. Carranza* (ANSM). **Nuevo León:** Municipio de Aramberri, 7.5 km E of Puentes on dirt road, 19 Sep 2003, 1775 m, *P.M. Peterson 17848, J. Valdés-Reyna & H.S. Hinton* (US); Municipio de Doctor Arroyo, 50 km al S de San José de las Raices, sobre la carretera a Matehuala, 14 Oct 1974, 1800 m, *J. Rzedowski, 32274* (MEXU); Dr. Arroyo, Nov 1980, 1750 m, *J.A. Ochoa 1273* (MEXU); Municipio de Galeana, 2 km S del Salero, 1 km E de carretera 57 Matehuala-Saltillo, 31 Jul 1983, 2050 m, *J. Valdés-Reyna 1615, L.E. Rodríguez* (ANSM, ENCB); *J. Valdés-Reyna & J.S. Marroquín s.n.* (IBUG); Near San Rafael (Hwy 57), 19 Sep 2001, 1900 m, *P.M. Peterson 15813, J. Valdés-Reyna* (US); 5.6 mi E of jct of Hwys 57 and 58 towards Linares, 17 Oct 1995, 1950 m, *P.M. Peterson 13294, M.B. Knowles* (US); La Chona, 19 Sep 2003, 1850 m, *P.M. Peterson 17824, J. Valdés-Reyna & H.S. Hinton* (US); 19 km SE of El Salero, 19 Sep 2003, 1707 m, *P.M. Peterson 17840, J. Valdés-Reyna & H.S. Hinton* (US); 20 km S of San Roberto along hwy 57, 18 Aug 1983, 1820 m, *S.L. Hatch 4941, J. Valdés-Reyna & J. Kessler* (ANSM); 5 km SE of intersection at Galeana along hwy 58, 54 km SE of San Roberto, 27 Aug 1981, 1350 m, *S.L. Hatch 4558, C.W. Morden & J. Valdés-Reyna* (ANSM); About 1 Mi S of Galeana, 4 Sep 1991, 1524 m, *K.W. Allred 5504, J.T. Columbus & J. Valdés-Reyna* (ANSM); About 3 Mi S of Galeana, 20 Jul 1958, *D.S. Correll 19851, I.M. Johnston* (MEXU); Alrededor de Galeana, Sep 1980, *J.A. Ochoa 1259* (MEXU); Ejido El Tokio, 22 Jul 1986, 1865 m, *M.L. Avalos s.n.* (ANSM, UAT); 19 Nov 1981, 1900 m, *O.L. Briones 470, J. Treviño* (ANSM); 29 May 1993, 1890 m, *J.L. Mora 343* (UAT); 4 mi al SE de Galeana, *J.F. Reeder & C.G. Reeder 3653* (ENCB); 3966 (US); Región de Galeana, *E. Hernández & V. Mathus N-2042* (CHAPA); 6 mi al N de San Roberto, *J.R. Reeder & C.G. Reeder 3651* (US); Galeana, Nov 1980, 1650 m, *J.A. Ochoa 998* (MEXU); Intersection of road to Nueva Primavera and road to Galeana coming from hwy 57, 26 Aug 1987, 1219 m, *D. Bogler 127, T. Atkins* (MEXU); La Becerra, 8 Sep 1989, 1950 m, *G.B. Hinton 19644* (MEXU); Salinas del Refugio, 26 Jul 1983, 1860 m, *J.S. Marroquín 3963* (ANSM, ENCB); Santa Rita, 5 km S de Galeana, 12 May 1991, 2150 m, *M.A. Carranza 1458, A. Rodríguez* (ANSM); Santa Rita, 5 km S de Galeana, 11 Dic 1991, 2300 m, *J.A. Villarreal 6318, M.A. Carranza* (ANSM); 5 km al E de Galeana, *I Cabral 1083-b* (IEB); Iturbide, Bosque-escuela, Universidad Autónoma de Nuevo León, 12 km E de Iturbide, 18 Nov 1987, 1500 m, *I. Cabral 1083* (ANSM).

4. **Bouteloua chondrosioides** (Kunth) Benth. ex S. Watson, Proc. Amer. Acad. Arts 18:179. 1883. (**Fig. 8**).

Dinebra chondrosioides Kunth, Nov. Gen. Sp. (quarto ed.) 1:173, t. 53. 1816. *Atheropogon chondrosiodes* (Kunth) Roem. & Schult., Syst. Veg. 2:416. 1817. Tipo: MÉXICO. Michoacán: Sep, *F. Humboldt & A. Bonpland s.n.* (holotipo: P; isotipos: LE, US fragm.!).

Bouteloua havardii Vasey ex S. Watson, Proc. Amer. Acad. Arts 18:179. 1883. Tipo: U.S.A. Texas: Limpio Mts., *V. Havard 53* (holotipo: US-81723!).

Plantas perennes, cespitosas. Culmos de 20 a 50 cm de alto, numerosos, erectos, simples; entrenudos 2 a 5, glabros; nudos glabros. Vainas glabras; lígula 0.2 a 0.4 mm de largo, un anillo ciliado; láminas foliares de 3 a 10(–18) cm de largo y 2 a 3 mm de ancho, aplanadas, glabras o piloso-papilosas. Inflorescencia de 3 a 7 cm de largo, con 3 a 8 ramificaciones primarias espigadas erectas o ascendentes, caedizas en la madurez; ramificaciones de 7 a 10 mm de largo, ascendentes a adpresas, portando 8 a 12 espiguillas; raquis de las ramificaciones fuertemente híspido, prolongado 3 a 5 mm más allá de la ramificación terminal, las espiguillas congestas, traslapándose densamente. Espiguillas de 6 a 11 mm de largo, permanecen insertas a las espigas; glumas con las quillas híspidas, los pelos largos con tintes purpúreos, primera gluma 2.5 a 3.5 mm de largo, angosta, segunda gluma 5 a 7 mm de largo, híspida en el dorso, ancha; lema de la flor perfecta de 5 a 6.5 mm de largo, híspida en 3/4 partes de su superficie, especialmente sobre las nervaduras, con 3 aristas iguales, de 2 a 3 mm de largo; pálea de igual tamaño que la lema o un poco mayor, híspida sobre los nervios principales hacia el ápice. Anteras de 2.8 a 3.5 mm de longitud, amarillas; estípite glabro; Flósculo rudimentario 1, reducido a 3 aristas de 2 a 7 mm de longitud, híspidas, la central frecuentemente con alas membranáceas. Cariopsis de 2 a 2.5 mm de longitud, color amarillo, oblongo-elipsoide. $2n = 20$, 40. Florece de agosto a diciembre.

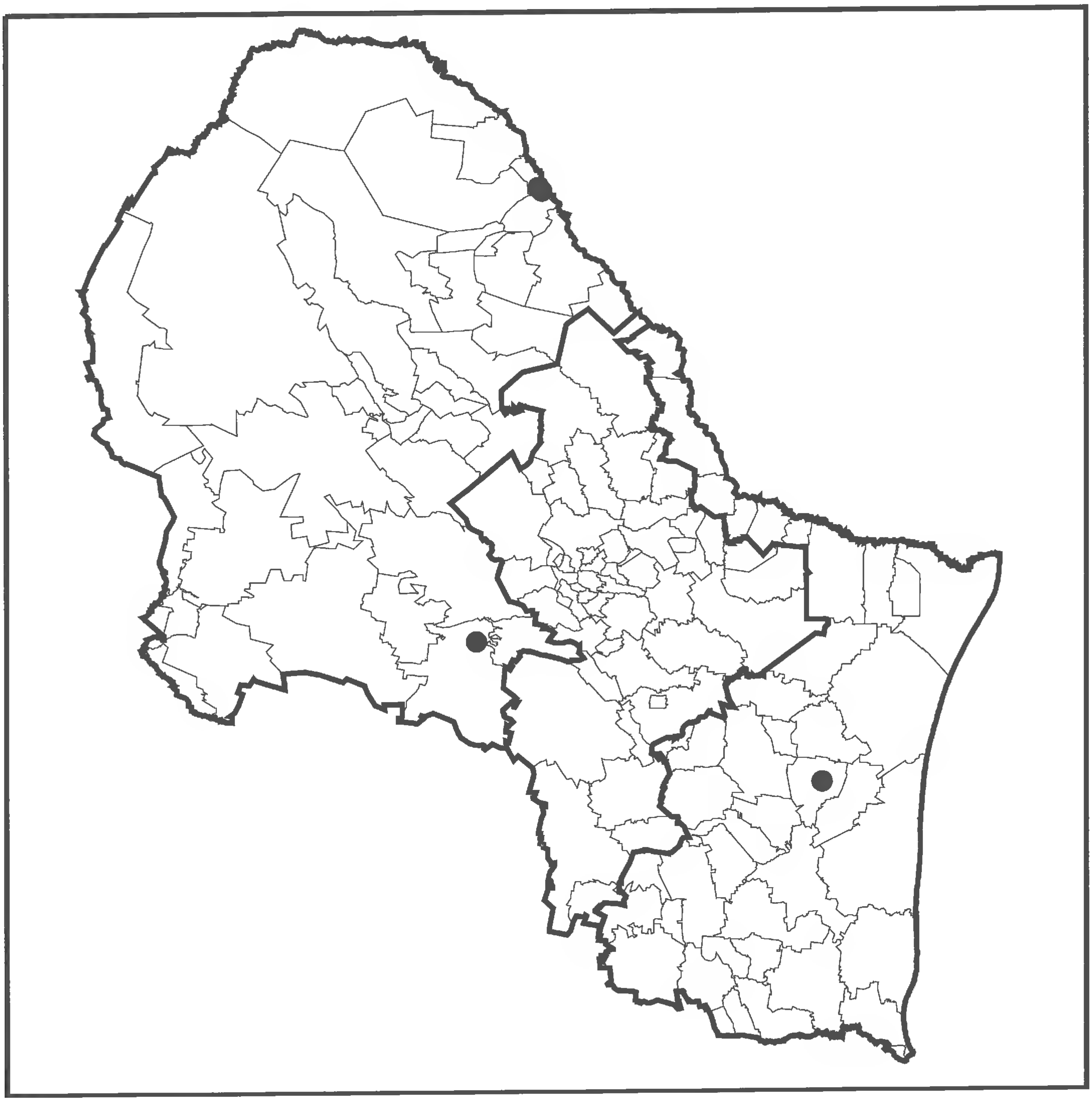


FIG. 8. Distribución de *Bouteloua chondrosoides* en el noreste de México.

Distribución.—S de Estados Unidos a todo el O de México.

Hábitat.—Pastizal y matorrales en suelos calcáreos; 50 a 1600 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Piedras Negras, calcareous mesas near Díaz, 20 Abr 1900, 244 m, *C.G. Pringle 9018* (MEXU); Municipio de Saltillo, Buenavista, 7 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., Nov 1975, 1600 m, *A. Aznar s.n.* (ANSM); 7 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., Sep 1975, 1770 m, *R. Palomo* s.n. (ANSM). **Tamaulipas:** Municipio de Jiménez, Ejido Sor Juana Inés de la Cruz, 29 Sep 1993, 150 m, *R.A. Carranco 401* (MEXU).

5. Bouteloua curtipendula (Michx.) Torr., Explor. Red River Louisiana 300. 1853. *Chloris curtipendula* Michx., Fl. Bor.-Amer. 1:59. 1803. *Dinebra curtipendula* (Michx.) P. Beauv., Ess. Agrostogr. 98, 158, 160. 1812. *Eutriana curtipendula* (Michx.) Trin., Fund. Agrost. 161. 1820. *Cynodon curtipendula* (Michx.) Raspail, Ann. Sci. Nat. (Paris) 5:303. 1825. *Andropogon curtipendulum* (Michx.) Spreng. ex Steud., Nomencl. Bot. ed. 2 1:90. 1840, *nom. inval. Atheropogon curtipendulus* (Michx.) E. Fourn., Mexic. Pl. 2:138. 1886. TIPO: U.S.A. ILLINOIS: 1795, *A. Michaux s.n.* (HOLOTIPO: P.; ISOTIPO: US fragm.!).

Plantas perennes, por lo general densamente cespitosas; rizomas ocasionalmente presentes. Culmos de 30 a 100 cm de alto, erectos, simples; estolones ocasionalmente presentes; entrenudos 2 a 3, glabros, nudos glabros. Vainas con pelos esparcidos de 1 mm de largo; lígula de 0.5 a 1 mm de largo, un anillo denso de pelos; láminas foliares 5 a 20(–35) cm de largo, y 3 a 7 mm de ancho, aplanadas, por lo general esparcido piloso-papilosas, principalmente en la base y en los márgenes. Inflorescencia de 9 a 20(–30) cm de largo, con (4-)30 a 80 ramificaciones primarias espigadas de 1 a 3 cm de largo, inclinadas, caedizas en la madurez, portando 2 a 7 espiguillas; espiguillas de 6 a 8 mm de largo, permanecen insertas a las ramificaciones; glumas desiguales, verdosas con tintes violáceos, escabrosas en la quilla, primera gluma de 3 a 4 mm de largo, angosta, glabra, segunda gluma de 5.5 a 8 mm de largo, más ancha, aguda hacia el ápice; lema de la flor perfecta 5 a 7 mm de largo, glabra a escabroso-pubescente, 3-nervada, las nervaduras extendidas como mucrones hasta de 1 mm de largo. Anteras 3 a 4 mm de largo, color anaranjado, ocasionalmente amarillas. Flósculo rudimentario 1, lema de 1.8 a 2 mm de largo, con 3 aristas, la central de 5(–10) mm de largo, las laterales más cortas. Cariopsis de 2 a 2.3(–4) mm de largo, cilíndrica, color amarillo. $2n$ = 20, 40, 41–64 (Gould, 1979), apomícticas en su mayoría.

Comentarios.—Gould (1979) reconoce tres variedades. La variedad típica es de amplia distribución en EUA; en México solamente se encontraron ejemplares de Coah. y Qro, sin embargo, las variedades *caespitosa* y *tenuis* son comunes y de amplia distribución en México.

CLAVE PARA LA DETERMINACIÓN DE LAS VARIEDADES DE *B. CURTIPENDULA*

1. Plantas densamente cespitosas, sin rizomas; culmos erectos, sin formar estolones; láminas foliares 3 a 5 mm de ancho, gruesas y rígidas, sin pubescencia de base papilosa ________ **5a. B. curtipendula** var. **caespitosa**

1. Plantas ligeramente cespitosas, con rizomas o estolones o culmos decumbentes rastreros; láminas foliares varios; pubescencia de base papilosa a veces presente.
   2. Rizomas presentes; culmos erectos, rígidos, fuertes, sin formar estolones; láminas foliares de (3.5–)5 a 7(–8) mm de ancho, color verde-azulosas, con pubescencia de base papilosa; inflorescencia larga con 40 a 70 ramificaciones primarias espigadas caedizas, anteras típicamente rojas o rojo-anaranjado ________ **5b. B. curtipendula** var. **curtipendula**
   2. Rizomas generalmente ausentes; culmos delgados, frágiles y decumbentes formando estolones; láminas foliares de 2 a 4 mm de ancho, color verde-amarillentas, glabras, las basales enroscadas; inflorescencia con 4 a 9 ramificaciones primarias espigadas; anteras amarillas o rojo-naranja ________ **5c. B. curtipendula** var. **tenuis**

5a. Bouteloua curtipendula var. **caespitosa** Gould & Kapadia, Brittonia 16:203, f. 43. 1964. (**Fig. 9**). Tipo: U.S.A. Arizona: Cochise Co. 3 mi E of Bisbee, 1725 m, 10 Aug 1962, *F.W. Gould 10021* (holotipo: TAES; isotipos: ARIZ, DS, GH, NY, TEX, UC, US-2473990!).

Bouteloua racemosa Lag., Varied. Ci. 2(4): 141. 1805. *Atheropogon racemosus* (Lag.) Roem. & Schult., Syst. Veg. 2:414. 1817. Tipo: MÉXICO: cultivado posiblemente en Madrid (holotype: MA).

Atheropogon acuminatus E. Fourn., Mexic. Pl. 2:139. 1886. *Atheropogon acuminatus* E. Fourn. ex Hemsl., Biol. Cent.-Amer., Bot. 3:564. 1885, *nom. nud. Bouteloua acuminata* (E. Fourn.) Griffiths, Contr. U.S. Natl. Herb. 14(3):406, f. 55. 1912. Tipo: MÉXICO: Mirador, Nov 1941, *F.M. Liebmann 583* (lectotipo, designado aquí: P!; isolectotipo: US-734843!).

Plantas densamente cespitosas, sin rizomas. Culmos 0.5 a 1 m de alto, rígidos, erectos, de base nudosa, dura pero sin formar estolones. Láminas foliares de largo variable, 3 a 5 mm de ancho, gruesas y rígidas, sin pubescencia de base papilosa. Inflorescencia de tamaño variable, con 30 a 80 ramificaciones primarias espigadas caedizas, portando 2 a 7 espiguillas. Espiguillas permanecen insertas a las ramificaciones, de color cobrizo, café-amarillento a pajizo o verde, con diversas manchas púrpura. Anteras amarillas o anaranjadas, ocasionalmente rojas o purpúreas. Cariopsis 2 a 2.3 mm de largo, color amarillo, oblongo-elipsoide. $2n$ = 20, 40, con aneuploide $2n$ = 42. Florece de junio a diciembre.

Distribución.—Amplia en casi todo México; Sudamérica en: Argentina, Bolivia, Ecuador, Perú, Uruguay y Venezuela.

Hábitat.—Se le encuentra en una gran diversidad de condiciones que va desde suelos arenosos, rocosos, arcillosos bien drenados de pastizales, matorrales y bosques de encino y pino; 115 a 2260 m.

Ejemplares examinados. **México. Coahuila:** Municipio de Acuña, Serranías del Burro, Rancho El Bonito, cañón el Toro, Acuña, *D.H.*

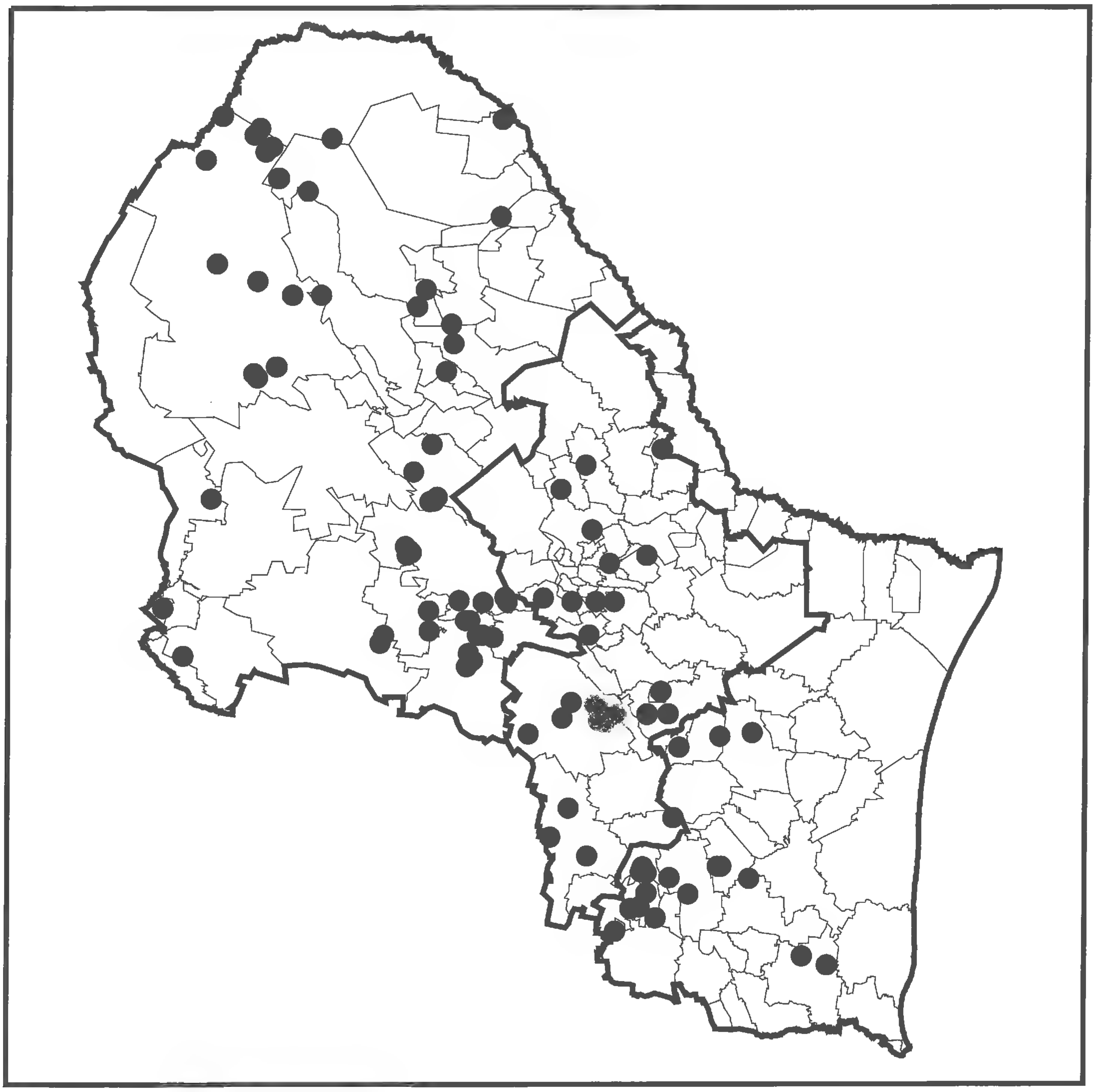


Fig. 9. Distribución de *Bouteloua curtipendula* var. *caespitosa* en el noreste de México.

Riskind 2170 (ANSM); Municipio de Arteaga, Sierra Hermosa, en la Sierra de Zapalinamé hacia el O rumbo al Cañón del Carbón, 8 Aug 1979, 2260 m, *R. López s.n.* (ANSM); Municipio de Castaños, Camino al Ejido San Francisco, 8 Jul 1993, 900 m, *E. Pérez 20* (MEXU); S end of Puerto San Lázaro (Cuesta La Muralla), 0.5 Mi N of San Lázaro along route 57, 2 Oct 1960, 1250 m, *M.C. Johnston 5882* (TAES); Sierra de la Gavia, Cañón la Gavia, 6 km S de la casa camino al cañón, 20 Sep 1989, 1480 m, *P.S. Hoge 320, M.E. Barkworth & M.A. Carranza* (ANSM); Al pie de la Sierra La Gavia, km 115 carr. 57 Saltillo-Monclova, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1487* (CIIDIR, HUAA); 25 mi SW de Sabinas, Monclova, *F. Wynd & C.H. Mueller 217* (US); Municipio de Cuatrociénegas, Puerto del Norte, Cuatrociénegas, *L.H. Harvey 1208* (US); Sierra Las Cautivas, 31.6 mi W of Ejido Guayabas and 5.4 mi W of Dulces Nombres, 25 Sep 2007, 1833 m, *P.M. Peterson 21071, J.M. Saarela* (US); Municipio de Francisco I. Madero, Old Candelilla camp, canyon in NO side of Sierra de Delicias, about 3 km S of Puerta de Sardinas, 9 Aug 1973, 1200 m, *M.C. Johnston, F. Chiang, T.L. Wendt, J. Henrickson & D. Morofka* (MEXU); Municipio de General Cepeda, Ejido La Rosa, carretera 40 Saltillo-Torreón, aprox. 20 km NE de General Cepeda, 5 Jul 1986, 1500 m, *S. Vásquez 96, A. García* (ANSM); 11 km W of Saltillo, G. Mick & K. Roe 19 (ENCB); Municipio de Jiménez, 6 mi S of Cd. Acuña, 24 May 1965, *F.W. Gould 11338* (TAES); Municipio de Morelos, Entre Nava y Morelos, *J. Crutchfield, J.C. Marshall & M.C. Johnston 5884* (US); Municipio de Múzquiz, Cerca de Muzquiz, *L.H. Harvey 1178* (US); 99.6 mi N of Melchor Muzquiz at Cuesta de Malena on Hwy 25 towards Bequillas del Carmen, 01 Sep 2006, 1574 m, *P.M. Peterson 19831, S. Lara-Contreras* (US); Madera del Carmen, 16.3 mi NE of Los

Pilares on road towards Campo Dos, 21 Sep 2007, 2235 m, *P.M. Peterson 20994, J.M. Saarela, S. Lara-Contreras & J. Reyna* (US); 22 km ESE of La Cuesta del Plomo on the Múzquiz-Boquillas hwy near the intersection of hwy from Villa Acuña, 7 Jun 1972, 1000 m, *F. Chiang 7539-A, T.L. Wendt & M.C. Johnston* (MEXU); 8 km SE de Palau, camino a Barroteras, 24 May 1977, 422 m, *J. Valdés-Reyna 937* (ANSM); La Cuesta del Plomo on the Múzquiz-Boquillas highway, 14 Sep 1972, 1750 m, *F. Chiang 9205, T.L. Wendt & M.C. Johnston* (MEXU); Municipio de Nava, Sierra El Jardín, Canyon del Diablo, 8 mi from jct of road towards Boquillas, 2 Sep 2006, 1336 m, *P.M. Peterson 19864, S. Lara-Contreras* (US); Sierra El Jardín, slopes above Canyon del Diablo, 2 Sep 2006, 1418 m, *P.M. Peterson 19889, S. Lara-Contreras* (US); Sierra El Jardín, 3 Sep 2006, 1446 m, *P.M. Peterson 19915, S. Lara-Contreras* (US); Municipio de Ocampo, 16 km by winding road almost due N of Ejido Piedritas, E Face of the Sierra which trends SSE from Cañon de San Vicente, 17 Sep 1972, 1050 m, *F. Chiang 9366-G, T.L. Wendt & M.C. Johnston* (MEXU); Sierra El Pino, 9.2 km SW of Rancho El Cimarron along the easter slopes, 14 Sep 1991, 1500 m, *P.M. Peterson 10628, & C.R. Annable* (US); Sierra Madera del Carmen, Villa Ocampo, *J. Passini & M.F. Robert 5312* (ENCB); Madera del Carmen, 9.7 mi NE of Los pilares, 21 Sep 2007, 1902 m, *P.M. Peterson 20943, J.M. Saarela, S. Lara-Contreras & J. Reyna* (US); Rancho experimental La Rueda, 87 km NE de Ocampo, brecha Ocampo-Boquillas del Carmen, 2 Jul 1991, 1350 m, *M. Vásquez s.n.* (ANSM); *D. Ibarra s.n.* (CIIDIR); *Y. Herrera Arrieta & A. Cortés 1456* (CIIDIR, HUAA); Sierra de la Madera, Rancho Laguna de la Leche, aprox. 62 km de Ocampo rumbo a Sierra Mojada, 2 Oct 1990, 1000 m, *M.A. Carranza 614, F.J. Carranza* (ANSM, CIIDIR); Municipio de Parras, km 30 carretera General Cepeda-Parras, 12 Sep 1986, 1500 m, *J. Espinoza 156* (ANSM, TAES); Municipio de Ramos Arizpe, 12 km E of Ramos Arizpe on the Monterrey highway, 24 May 1973, 1250 m, *M.C. Johnston 11214-A, T.L. Wendt & F. Chiang* (MEXU); km 30, carr. 40 Saltillo-Monterrey, Ramos Arizpe, *Y. Herrera Arrieta & A. Cortés 1474* (CIIDIR, HUAA); San Juan de las Bonitas, 19 Jul 1993, 1450 m, *F. Alcalá 13* (MEXU); 20 Jul 1993, 1450 m, *E. Pérez 29* (MEXU); Sierra de la Paila, Ejido el Cedral por el camino El Carmen, 4 Oct 1989, 1300 m, *J.A. Villarreal 5333, M.A. Carranza & A. Rodríguez* (ANSM); 6 Aug 1975, 1800 m, *M.F. Robert 4539, J. Passini* (ANSM); *M.F. Robert 4601, J. Passini* (ENCB); *M.F. Robert 9118, J. Passini* (UAG); Municipio de Saltillo, 29 km S Saltillo on Mex 54 and 2.1 km W on road to Microondas, just W of Estacion Carneros, 18 Oct 1989, 2250 m, *P.M. Peterson 8412, M.A. Carranza* (US); 5 mi W of Chapultepec on cutoff road between Hwy 54 & 57, 23 mi S of Saltillo, 16 ct 1995, 2410 m, *P.M. Peterson 13269, M.B. Knowles* (US); Buenavista, 7 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 28 Jun 1972, 1750 m, *R. Almeida 1580, M. Torres* (ANSM); Rancho experimental Los Angeles, 48 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 4 Nov 1962, 1800 m, *F.W. Gould 10302* (TAES); 48 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 14 Nov 1992, 1800 m, *J.A. Villarreal 6715, M.A. Carranza & D.E. Lozano* (ANSM); Sierra de Zapalinamé, Cañón de San Lorenzo, 5 km S de Saltillo, 25 Aug 1981, 1950 m, *S.L. Hatch 4476, C.W. Morden & J. Valdés-Reyna* (ANSM, TAES); Cañón de San Lorenzo, 8 km S de Saltillo, 6 Oct 1979, 1950 m, *R. López 6* (ANSM); 2 km al N de Cañada Blanca, km17 carr. 57 Saltillo-Monclova, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1482* (CIIDIR, HUAA); 22.5 mi SW of Saltillo, *F.W. Gould 8693* (ENCB); Municipio de Torreón, Sierra de Jimulco, N-facing cliffs, NO-facing notches, 27 Jun 1972, 1600 m, *M.C. Johnston 11485, T.L. Wendt & F. Chiang* (MEXU); E of Torreón, 5.1 km SE of Estacion La Cuchilla on Mex 40 to Saltillo, 20 Oct 1989, 1100 m, *P.M. Peterson 8446, J. Valdés-Reyna, J.A. Villarreal & P.A. Fryxell* (US). **Nuevo León:** Municipio de Cadereyta Jiménez, En los alrededores del poblado de Cadereyta, 22 Mar 1993, 320 m, *N. Bazaldua 36* (MEXU); Municipio de Carmen, Meseta de Chipinque, San Pedro Garza García, 5 Jun 1992, *M.M. Castillo 7* (MEXU); Municipio de Dr. Arroyo, 12 mi N of Matehuala, ½ mi N of San Luis Potosi line, 16 Sep 1963, 1800 m, *F.W. Gould 10753* (TAES); Ejido Lagunita y Ranchos Nuevos, Dr. Arroyo, *M.E. Pérez 120* (CIIDIR); Municipio de Galeana, 1 mi E of San Marcos, 13 mi SE of Galeana, 13 Sep 1963, 1850 m, *F.W. Gould 10726* (TAES); 1.5 km E of El Barrosito, 1.5 km O of Puerto Prieto, in S part of Sierra la Tomita, 19 Jun 1972, 2100 m, *F. Chiang 8014, T.L. Wendt & M.C. Johnston* (MEXU); 7 km of hwy 57, on the road to El Carmen, near Cerro de la Conformidad, 19 Jun 1972, 2150 m, *F. Chiang 8029a, T.L. Wendt & M.C. Johnston* (MEXU); km 63.6 carretera Galeana-San Roberto, 18 Nov 1987, 1900 m, *I. Cabral 1084* (ANSM, IEB); Sierra Madre Oriental, about 15 mi SO of Galeana, 13 Jul 1934, *C.H. Mueller 1087, M.T. Mueller* (MEXU); Galeana, *V.H. Chase 7632* (US); SW de Galeana, *C.H. Mueller & H. Mueller 497* (US); Municipio de Iturbide, 1 mi O of Iturbide, 30 Sep 1976, 1570 m, *J. Brunken 203, C. Perino* (TAES); 11 mi E of Iturbide, Mex. 60, 30 Sep 1976, 700 m, *J. Brunken 198, C. Perino* (MEXU, TAES); Municipio de Juárez, Rancho San Marcos, km 7 camino a San Mateo, carretera Villa de *Juárez*-Cadereyta, 1 Jun 1993, *J. Garza 28* (MEXU); Municipio de Lampazos de Naranjo, Aprox. 5 km O del Rancho Pascualito, 16 Feb 1980, 440 m, *O.L. Briones 107* (ANSM); Municipio de Linares, Los Pinos, 12 Oct 1980, 1300 m, *J.J. Ortíz s.n.* (ANSM); Rancho San José de los Hoyos, km 15 carretera Linares-Iturbide, 1 Abr 1993, *J. Garza 20* (MEXU); 11 mi E de Iturbide, carr. Linares-Galeana, *M.C. Johnston 5841* (US); Municipio de Marín, Facultad de Agronomía, Universidad Autónoma de Nuevo León, km17, Marín, 22 Oct 1992, *M.M. Castillo 25* (MEXU); Municipio de Monterrey, Vecindad del Cerro del Obispado, Monterrey, *F. Barkley 14497* (US); km 105 carr. Monterrey-Cerralvo, *N.L. Bendeck 205* (CIIDIR); Municipio de Sabinas Hidalgo, Carretera Monterrey-Sabinas Hidalgo, km 82, 24 Mar 1993, 380 m, *N. Bazaldua 56* (MEXU); Municipio de Salinas Victoria, Sierra de Mamulique, 29 Ene 1993, *M.M. Castillo 42* (MEXU); Municipio de Santiago, Puerto Genovevo, 11 Sep 1986, 1150 m, *I. Cabral 515* (ANSM). **Tamaulipas:** Municipio de Bustamante, 10 km al NE de la Verdolaga, 5 Aug 1985, 1800 m, *P. Hiriart 846, R. Molczadzki & V. Juárez* (MEXU); 2 km NO de Felipe Angeles rumbo a Bustamante, 9 Nov 1984, 1600 m, *R. Díaz 180* (UAT); Municipio de González, 24 km al NO de González, 11 Jun 1992, 115 m, *J.G. Galván 272* (MEXU); 5 km al N de González, Mar 1991, 110 m, *J.G. Galván 259* (MEXU); Municipio de Jaumave, 7 km al N de Magdaleno Aguilar (Santiaguillo), 18 Sep 1976, 1850 m, *F. González 9801, A. Castellanos & P. Zavaleta* (MEXU); Sierra Madre rumbo a Jaumave, *R. Carranco 089* (IEB); Municipio de Llera, La Herradura, 7 Oct 1980, 380 m, *C. Pantoja 1* (MEXU); Municipio de Miquihuana, 2 km al SO de Miquihuana, 13 Aug 1989, 1600 m, *A. Mora 978* (ANSM, UAT); Ejido Valle Hermoso, Miquihuana, *R. Carranco 062* (IEB); 3 mi al N de Miquihuana, *L.R. Stanford 2465* (US).Municipio de Palmillas, San Pedro, 6 km al NO de Municipio Palmillas, 13 Aug 1984, 1600 m, *P. Hiriart 227, F.V. Juárez, M. González, A. McDonall, M. Ortega y R. Díaz* (MEXU); Municipio de San Carlos, Cerro del Diente, *J.A. Barrientos 080* (IEB); Municipio de Tula, 11 Mi S of Palmillas on the road to Tula, 18 Sep 1960, *M.C. Johnston 5628, J. Crutchfield* (MEXU,

US); La Tapona, 21 Oct 1982, 1900 m, *R.A. Carranco 159* (MEXU); Municipio de Victoria, Altas Cumbres, 18 Oct 1982, 1240 m, *J.G. Galván 55* (MEXU); 11 mi SW de Victoria, *L.R. Stanford 1995* (US); Municipio de Villagrán, 1 Mi E of Ejido de San Lázaro, 11 Oct 1959, 457 m, *M.C. Johnston 4290, J. Graham* (MEXU); On highway 85, between Linares and Ciudad Victoria, 111 km NO of Ciudad Victoria, 24 Jun 1977, 415 m, *T.B. Croat 39199* (MEXU).

5b. Bouteloua curtipendula var. curtipendula (Fig. 10).

Atheropogon apludioides Muhl. ex Willd., Sp. Pl. 4:937. 1806. Tipo: NORTH AMÉRICA: (holotipo: ?; isotipo: US-1535780 fragm.!).

Eutriana affinis Hook. f., Trans. Linn. Soc. London 20:174. 1847. *Atheropogon affinis* (Hook. f.) E. Fourn., Mexic. Pl. 2:141. 1886. Tipo: U.S.A. Missouri: St. Louis, *Schweinitz s.n.* (sintipo: K); Texas: *Drummond s.n.* (sintipo: US-1063204 fragm.!).

Bouteloua curtipendula var. *aristosa* A. Gray, Manual (ed. 2) 553. 1856. *Bouteloua racemosa* var. *aristosa* (A. Gray) S. Watson & J.M. Coult., Manual (ed. 6) 656.1890. Tipo: U.S.A. Illinois: *Geyer s.n.* (holotipo: GH!).

Plantas ligeramente cespitosas, con rizomas presentes, delgados o fuertes. Culmos erectos, rígidos, fuertes, solitarios o en pequeños grupos. Láminas foliares de (3.5–)5 a 7(–8) mm de ancho, aplanadas, color verde-azulosas, con pubescencia de base papilosa. Inflorescencia típicamente larga con 40 a 70 ramificaciones primarias espigadas caedizas, reflejas, sobre un eje fuerte, portando 3 a 7 espiguillas. Espiguillas permanecen insertas a las ramificaciones; glumas y lema típicamente color púrpura o teñidas de púrpura. Anteras color rojo o rojo-anaranjado, muy esporadicamente anaranjadas, amarillas o purpúreas. $2n = 40$, se le conocen varios casos de aneuploidía con 41 a 64 cromosomas. Florece de junio a diciembre.

Distribución.—Desde el S de Canadá, Planicies del centro de Estados Unidos al Sur hasta México en: Coahuila, Chihuahua, Durango, Nuevo León, San Luis Potosí y Tamaulipas.

Hábitat.—Especie característica de pastizales, matorrales y bosques de encino y pino sobre suelos arcillosos y bien drenados; 60 a 2500 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Acuña, 1936, (MEXU); Municipio de Allende, 13 Mi SO of Ciudad Allende toward Sabinas, 7 Oct 1959, 488 m, *M.C. Johnston 4176, J. Graham* (MEXU); Municipio de Arteaga, Arroyo Canoas, 28 Aug 1993, 1600 m, *F. Alcalá 23* (MEXU); Municipio de Castaños, La Muralla km 135 carretera Saltillo-Monclova, 15 Nov 1974, 750 m, *H.M. Garza s.n.* (MEXU); Municipio de Castaños, Paso de San Lázaro, Sierra La Gavia, 37.6 Mi S de Monclova, carretera 57, 22 Sep 1990, 1250 m, *P.M. Peterson 9982, C.R. Annable & J. Valdés-Reyna* (ANSM, US); Sierra de la Gavia, Cañón de la Gavia, aprox. 6 km S de la casa camino al cañón, 14 Aug 1986, 1480 m, *J. Valdés-Reyna 1712, M.A. Carranza & D. Frame* (ANSM, IEB); Municipio de Cuatrociénegas, Vecindad de Aguaje del Pajarito, Cañón al W de Sierra de la Fragua, 2–3 kmN de Puerto Colorado, 1–3 Sep 1941, *I.M. Johnston 8792* (US); Cañón del Agua (N-draining): mouth of canyon, rocky hilltop along road 0.1 mi N of Ranchito, 26 Aug 1977, 1420 m, *J. Valdés-Reyna, T.L. Wendt* (ANSM); Cerros entre Cuatrociénegas y Ocampo-Cuatrociénegas, 8 Jul 1987, 2500 m, *A. Rodríguez 939, J.J. López & J.L. Elizondo* (ANSM); Sierra de San Marcos, cañón Grande, Ejido Estanque de Norias, aprox. 43 km O de la carretera 57 rumbo a Ejido Reforma, 1 Oct 1993, 1550 m, *M.A. Carranza 1709, J.A. Encina, J. Fierro & R. Rodríguez* (ANSM); Cañón del agua, Cuatrociénegas, *J. Valdés-Reyna & T. Wendt VR-1009* (ANSM); Municipio de Monclova, Sierra de la Gloria: in Cañón del Chilpitín, 5 Mi up (E) from mouth of canyon, near El Chilpitín, at junction of main canyon, 7 Sep 1976, 1060 m, *T.L. Wendt 1686, D.H. Riskind* (MEXU); Municipio de Múzquiz, El Sauz, entronque carretera 57, 32 km S de Sabinas, 5 Sep 1990, 420 m, *R. Vásquez 217* (ANSM); Palm Canyon, 19 Sep 1936, *E.G. Marsh Jr. 980* (MEXU); Sierra del Carmen, Ejido San Francisco, 5 Sep 2005, 1430 m, *P.M. Peterson 18840, J. Valdés-Reyna & C. Sifuentes* (US); Sierra Maderas del Carmén, 17 Sep 1989, 1850 m, *E.A. Estrada 1839* (ANSM); Sierra del Carmén, Cañón de la Carbonera, 12 Aug 1975, 1900 m, *M.F. Robert 5633, J. Passini* (ANSM); Canyon del Centinela, on Hacienda Piedra Blanca, 10 Jul 1936, 2200 m, *L.F. Wynd 642, C.H. Muller* (ANSM); Mesa del Cinco, 13 Aug 1975, 2480 m, *M.F. Robert 5528, J. Passini* (ANSM); Sierra Maderas del Carmen, 17 Sep 1989, 1800 m, *E.A. Estrada s.n.* (ANSM); Sierra Madre Oriental, Cuesta la Encantada, 16 Aug 1975, 1400 m, *M.F. Robert 5661-A, J. Passini* (ANSM); Municipio de Ocampo, 5 kmO of Santa Elena. Vicinity of Santa Elena Mines, calcareous eastern foothills of the Sierra de las Cruces, 16 Jul 1941, *R.M. Stewart 832* (MEXU); Sierra El Pino, 33.5 km W of Rancho El Cimarron, 14 Sep 1991, 1500 m, *P.M. Peterson 10680, 10681 & C.R. Annable* (US); Cuesta de Zozoya, aprox. 38 km de Ocampo rumbo a Sierra Mojada, 3 Oct 1990, 1600 m, *M.A. Carranza 677, F.J. Carranza* (ANSM); Ocampo, Aug 1972, 1240 m, *R. Vásquez* y *Noriega* (ANSM); Rancho experimental La Rueda, 87 km NE de Ocampo, brecha Ocampo-Boquillas del Cármen, 31 Jul 1979, 1200 m, *M.T. Ruíz, M.A. Carranza & M. Vásquez* (ANSM); *D. Ibarra* (ANSM); Sierra de la Madera, 25 Jul 1973, *J.S. Marroquín 2388* (MEXU); Sierra del Cármen Campo 1, 12 Aug 1975, 1750 m, *M.F. Robert 5555, J. Passini* (ANSM); Sierra del Pino, Cañón de la Vaca, 14 Aug 1975, 1450 m, *M.F. Robert 5224, J. Passini* (ANSM); Sierra La Encantada, rancho Puerto del Aire, 8 Sep 1990, 1250 m, *M.A. Carranza 729, J. Valdés-Reyna, P.A. Fryxell, R. Vásquez & O. Meza* (ANSM, UAT); Sierra Madre Orientale, San José de las Piedras, 15 Aug 1975, 1200 m, *M.F. Robert 5661, J. Passini* (ANSM); Municipio de Parras, 9 km S of Parras on Sierras Negras, 3 Jul 1941, 2400 m. *L.R. Stanford 195, K.L. Retherford & R.D. Northcraft* (MEXU); Municipio de Ramos Arizpe, Sierra de la Paila, Ejido el Cedral por el camino El Cármen, 26 Aug 1992, 1300 m, *J. Valdés-Reyna 2171* (ANSM); Municipio de Sabinas, 35 mi NW del Rancho Margaritas, 100 mi NW de Sabinas, *F.W. Gould 10681* (US); 26 Jul 1973, 330 m, *2567* (ANSM); 85.4 km NW of Muzquiz on Hwy 53 towards Boquilla del Carmen, vía La Rosita, 12 Sep 1991, 810 m, *P.M. Peterson 10574, C.R. Annable* (US); Municipio de Saltillo, 2 km E de Saltillo, carretera Saltillo-Torreón, 6 Nov 1972, 1400 m, *R. Almeida 1631, 1640* (ANSM); A 2 km por la desviación Estación Guajar-

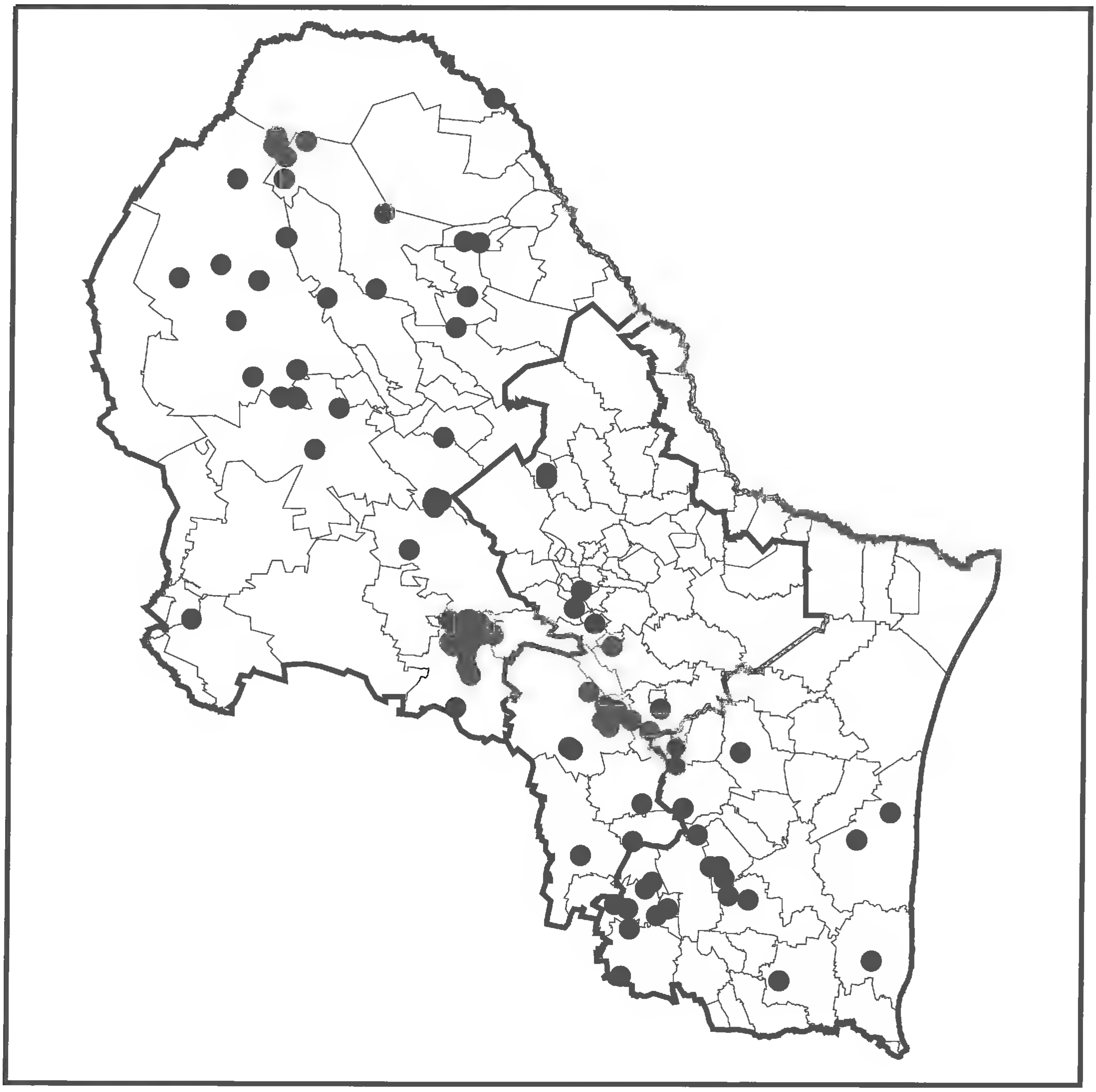


Fig. 10. Distribución de *Bouteloua curtipendula* var. *curtipendula* en el noreste de México.

do, carretera Saltillo-Torreón, 19 Oct 1986, 1620 m, *E. García s.n.* (ANSM); About 4 Mi O of Saltillo, 12 Aug 1950, *J.R. Reader 1656, C.G. Reeder & L.N. Goodding* (MEXU, TAES); Above the road on Diamonte, 14 Mi S of Saltillo, 2 Jul 1947, *F.A. Barkley 7193, G.L. Webster & C.M. Rowell Jr.* (MEXU); Area del Rastro Municipal, Buenavista, 21 Sep 1973, 1756 m, *R. Almeida 2600* (MEXU); Cañón de San Lorenzo, rumbo a los Aguajes, camino a los Burros, 17 Aug 1979, 1900 m, *R. López s.n.* (ANSM); El Refugio, S de Saltillo, Jul 1942, 1600 m, *E. Lyonnet 3551* (MEXU); La Encantada a 17 km de Saltillo carretera a Zacatecas, 9 Jun 1972, 1880 m, *R. Almeida 1342, B.J. García* s.n. (ANSM); Lomas las Tetillas, 19 Jul 1993, 1700 m, *J.A. García 19* (MEXU); Rancho experimental Los Angeles, 48 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 30 Jun 1978, 2000 m, *J.S. Sierra s.n.* (ANSM); Rancho Los Angeles, km 30 carretera Saltillo-Concepción del Oro, Zac., 31 Oct 1978, *F. Cárdenas, M.A. Bernal* (MEXU); Rumbo al Cañón El Cuatro, 19 Jul 1993, 1940 m, *P. Moya 421* (MEXU); Saltillo, 1898, *E. Palmer 407* (MEXU); Sierra de Catana, 40 km SO de Saltillo, 29 Jul 1992, 2700 m, *J.A. Villarreal 6572, M.A. Carranza., J. Valdés-Reyna, M. Vásquez y D.E. Lozano* (ANSM); Sierra de Zapalinamé, 5 km S de Saltillo, in San Lorenzo canyon, 25 Aug 1981, 2000 m, *S.L. Hatch 4493, C.W. Morden & J. Valdés-Reyna* (ANSM, ENCB); Sierra de Zapalinamé. Lomas de Lourdes, 3 Oct 1974, 1800 m, *V.M. Valdés s.n.* (ANSM); Municipio de San Buenaventura, Sierra La Encantada, rancho Carrizalejo, entrada S al rancho Puerto del Aire, 8 Sep 1990, 1200 m, *M.A. Carranza 771, J. Valdés-Reyna, P.A. Fryxell, R. Vásquez* & O. Meza (ANSM); Municipio de Buenavista, 29 Oct 1974, 1700 m, *G. I. Flores s.n.* (MEXU); 7 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zacatecas, 15 Oct 1974, 1750 m, *A. Rodríguez 104* (ANSM); 7 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 28 Aug 1982, 1756 m, *J.A. Villarreal 1692* (ANSM); 7 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 13 Aug 1980, 1850 m, *J.A. Villarreal 862, R. López* (ANSM). **Nuevo León:** Municipio de Bustamante, En el Cañón de Bustamante, 18 Jun 1993, 600 m, *P. Jáuregui 68* (MEXU); Grutas de Bustamante, 18 Jun 1993, 1300 m, *P. Jauregui 77* (MEXU); Municipio de Dr. Arroyo, 8.8 km W of Dr. Arroyo and 37 km E of Matehuala on Hwy 3, 13 Oct 1991, 1950 m, *P.M. Peterson 11138, C.R. Annable* (US); Municipio de Galeana, 3 km S of El Salero, 19 Sep 2003, 1869 m, *P.M. Peterson 17836, J. Valdés-Reyna & H.S. Hinton* (US); 25 km E of San Roberto along highway 58, 27 Aug 1981, 1740 m, *S.L. Hatch 4563, C.W. Morden & J. Valdés-Reyna* (ANSM, TAES). **Tamaulipas:** Municipio de Aldama, 31 May 1980, *R. Sandoval 9* (MEXU); Municipio de Hidalgo, Ejido Nicolás Bravo, 29 Oct 1981, *J. Cantú 41* (MEXU); Municipio de Llera, About 30 Mi S of Ciudad Victoria on highway 85, toward Ciudad Mante, 28 Sep 1976, 450 m, *F.W. Gould 14817* (ANSM, ENCB); Municipio de Victoria, Altas Cumbres, 19 Oct 1982, 1220 m, *J.G. Galván 60* (MEXU). Municipio de Allende, Along highway 85, 2 Mi S of Allende. Just S of river and bridge, 13 Oct 1980, *J.A. Wussow 258, G. Landry* (MEXU); Municipio de Galeana, 1 Mi S of Saltillo on México 57, 1 Oct 1960, *M.C. Johnston 5863*^{a}, *J. Crutchfield* (MEXU); 25 km E of San Roberto along highway 58, 27 Aug 1981, 1740 m, *S.L. Hatch 4570, C.W. Morden & J. Valdés-Reyna* (ANSM); 2 mi W of Dieciocho de Marzo up road towards Cerro Potosí, 18 Oct 1995, 2130 m, *P.M. Peterson 13322, M.B. Knowles* (US); En los alrededores del poblado Santa Clara de González, 16 Jul 1993, 1940 m, *N. Bazaldua 112* (MEXU); Hacienda de San José de Raices, 31 Jul 1935, *C.H. Mueller 2309b* (MEXU); La Becerra, 12 Sep 1989, 2100 m, *G.B. Hinton 19681* (MEXU); Municipio de General Zaragoza, Peña Nevada, 16 Nov 1977, *H. Brailovsky* (MEXU); 42 km SW of Hwy 85 on road towards Dulces Nombres, 23 Sep 2001, 1145 m, *P.M. Peterson 15907, J. Valdés-Reyna* (US). Municipio de Guadalupe, La Pastora, near La Ciudad de los Niños, Guadalupe, 15 Aug 1983, 500 m, *S.L. Hatch 4837, J. Valdés-Reyna & J. Kessler* (ANSM); Municipio de Iturbide, 5 Mi above (O of) Iturbide on the Linares-Galeana highway, 30 Sep 1960, *M.C. Johnston 5849* (MEXU); Cañada Marrubial, Santa Rosa, 7 Jul 1985, 1320 m, *B.A. Treviño 505* (MEXU); Municipio de Linares, Ejido Rancho Viejo, 9 Oct 1980, 850 m, *J.J. Ortíz s.n.* (ANSM); Localizado en el rancho El Nogalar, ubicado en la carretera Linares-San Roberto, km 12, 2 Jun 1983, 440 m, *M.M. Castillo 100* (MEXU); Municipio de Monterrey, Sierra Madre mountains, 29 Jul 1933, *C.H. Mueller 422, M.T. Mueller* (MEXU); Santiago, 22 km O de Villa de Santiago, 2 Aug 1976, 1800 m, *V. Valdés-Reyna 108* (ANSM). **Tamaulipas:** Municipio de Bustamante, 15 km al S de Miquihuana, 23 Aug 1984, *P. Hiriart 300, V. Juárez & R. Molczadzki* (MEXU); Cerro Tinaja. Vicinity of San José, 14 Jul 1930, 869 m, *H.H. Bartlet 10324* (MEXU, US); Municipio de González, 14 mi E of Mante toward González, 10 Dic 1959, 183 m, *M.C. Johnston 4917* (MEXU); Municipio de Gómez, Aserradero Revilla, 4 Nov 1982, 1700 m, *G. Villegas 539* (MEXU); Municipio de Jaumave, Altas Cumbres km 160 carretera Victoria-Jaumave, 29 Jun 1985, 950 m, *M. Martínez & Díaz de Salas 731* (UAT); S de Alta Cumbres, 10 Sep 1984, 1200 m, *A. McDonald 853* (UAT); Municipio de Hidalgo, Sierra La Lagunita, 6.4 mi SE of Aramberri on road towards Agua Fría, 19 Sep 2002, 1397 m, *P.M. Peterson 16678, J. Valdés-Reyna & M. Sosa* (US); Municipio de Miquihuana, Sierra de Los Lobos, Colonia Agrícola la Peña, 26 Nov 1981, 1800 m, *J.A. Barrientos s.n.* (MEXU); Municipio de San Carlos, Cerro de San Carlos, 21 Aug 1980, 1000 m, *G. Villegas 567* (MEXU); E La Gavia, 3 Sep 1981, 300 m, *J.F. Iribe 73* COCA); Municipio de Soto la Marina, 3 mi N of Soto la Marina on the road to Jiménez, 11 Dic 1959, 183 m, *M.C. Johnston 4973, J. Crutchfield* (MEXU); Ejido Verde Chico, 23 Oct 1986, 60 m, *J.F. Iribe 327* (MEXU); Municipio de Tula, 2 km al N de la Verdolaga, cerca de las Antonias, 12 Aug 1972, 1300 m, *F. González 4601, R.M. López & R. Dirzo* (MEXU); 30 km al SO de Tula, cerca del límite de estados (San Luis Potosí y Tamaulipas), 9 Aug 1972, 2000 m, *F. González 4439, R.M. López & R. Dirzo* (MEXU); 5 km al O del Ejido El Salitrillo, 3 Jul 1985, 1500 m, *P. Hiriart 759, V. Juárez & R. Molczadzki* (MEXU); Ejido La Presita en el km 66 carretera Tula-Victoria, 18 Jul 1986, 1600 m, *M. Martínez & Díaz de Salas 1221* (MEXU, UAT); Municipio de Victoria, 11 mi O of Victoria toward Jaumave, 29 Sep 1951, 914 m, *M.C. Johnston 4141D* (MEXU); Los San Pedros, 18 Sep 1980, *R.A. Carranco 615* (MEXU); On Jaumave road about 13 mi SO of Ciudad Victoria; near summits of Sierra Madre, 13 May 1949, 1000 m, *R. McVaugh 10500* (MEXU); 5 km O de Palmillas carretera Victoria-San Luis Potosí, 13 Jul 1984, 1580 m, *R. Díaz 8* (UAT); Municipio de Ciudad Victoria, 25 May 1988, 320 m, *J. Delgado s.n.* (UAT); Municipio de Villagrán, 3 mi N of Villagrán on the Victoria-Linares highway, 12 Nov 1959, 488 m, *M.C. Johnston 4672*^{a}, *J. Graham* (MEXU).

5c. Bouteloua curtipendula var. **tenuis** Gould & Kapadia, Brittonia 16:201.1964. (**Fig. 11**). TIPO: MÉXICO. ZACATECAS: 10 mi NW of Somrerete (68 mi SE of Durango), 30 Oct 1959, *F.W. Gould 9000c* (HOLOTIPO: TAES; ISOTIPOS: TEX, UC, US-2551354!).

Plantas ligeramente cespitosas, rizomas generalmente ausentes; culmos delgados, frágiles y decumbentes formando estolones bien desarrollados o culmos estoloníferos. Láminas foliares 8 a 15 cm de largo y 2 a 4 mm de ancho, aplanadas, de en la base y largamente apiculadas, color verde-amarillentas, las basales enroscadas cuando secas. Inflorescencia con 4 a 9 ramificaciones primarias espigadas espaciadas en el raquis; espiguillas color café a cobrizo, con tintes purpúreos. Anteras amarillas o anaranjadas. Cariopsis de 2 a 2.2 mm de largo, color amarillo, oblongo-elipsoide. Plantas sólo diploides $2n = 20$ y aneuploide $2n = 42$ cromosomas. Florece de julio a noviembre. Mapa 5c.

Distribución.—Especie mexicana encontrada en casi todo México.

Hábitat.—Pastizales abiertos sobre suelos fértiles; 710 a 1750 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de General Cepeda, Ejido La Rosa, carr. 40, Saltillo-Torreón, aprox. 20 km al NE de Gral. Cepeda, *S. Vázquez & A. García 96* (ANSM, SLPM). **Nuevo León:** Municipio de Montemorelos, Rancho Sta. Ana, 2 kmal E de Estación Huerta, aprox. 37 km SE de Montemorelos, *F.W. Gould 12800, 12860* (US); Dulce Nombre, *F.G. Meyer & D.J. Rogers 2888*

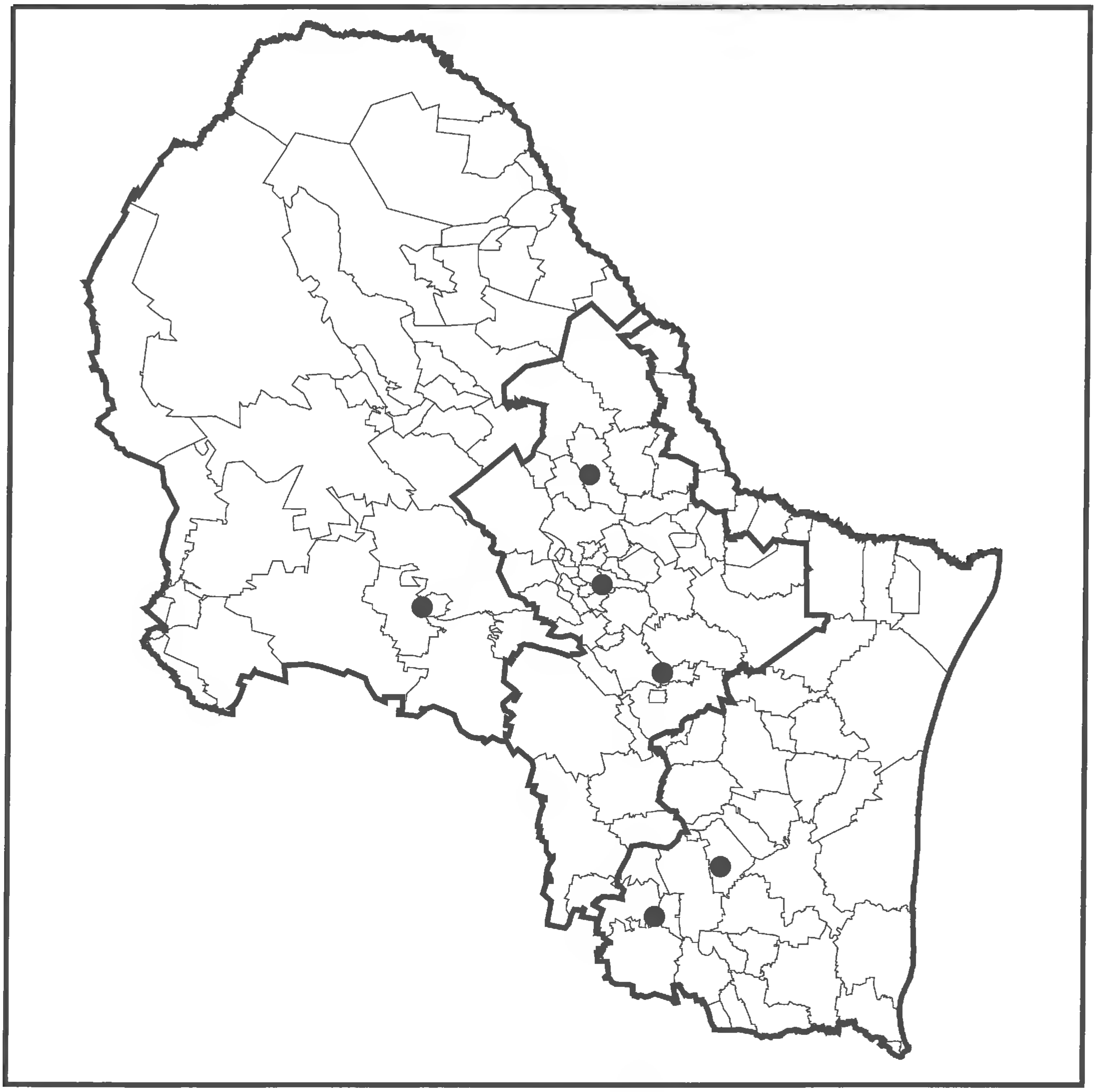


Fig. 11. Distribución de *Bouteloua curtipendula* var. *tenuis* en el noreste de México.

(US); Municipio de Sabinas Hidalgo, Paso a Mamalique, 7 Jul 1940, *I.K. Langman 2447* (US). **Tamaulipas:** 11 mi S of Palmillas camino a Tula, *M.C. Johnston & C. McMillan 6088* (US); *M.C. Johnston & J. Crutchfield 5628, 5722^a, 6074* (US); *F. Martínez & G. Borja F-2262, F-2330, F-2365* (US); *J.R. Swallen 1685* (US); Hacienda Buenavista, 21 Jun 1919, *E.O. Wootom s.n.* (US); Municipio de Victoria, Altas Cumbres, 7 Oct 1976, 710 m, *G. Villegas 17* (MEXU).

6. Bouteloua dactyloides (Nutt.) Columbus, Aliso 18(1):63. 1999. (**Fig. 12**). *Sesleria dactyloides* Nutt., Gen. N. Amer. Pl. 1:65. 1818. *Calanthera dactyloides* (Nutt.) Kunth ex Hook., Hooker's J. Bot. Kew Gard. Misc. 8:18. 1856. *Buchloe dactyloides* (Nutt.) Engelm., Trans. Acad. Sci. St. Louis 1:432, pl. 12 & 14, f. 1–17. 1859. *Casiostega dactyloides* (Nutt.) E. Fourn., Bull. Soc. Roy. Bot. Belgique 15:470. 1876. *Bulbilis dactyloides* (Nutt.) Raf. ex Kuntze, Revis. Gen. Pl. 2:763. 1891. Tipo: U.S.A.: Plains of the Missouri River, *T. Nuttall s.n.* (holotipo: BM; isotipo: PH?).

Planta baja, estolonífera, dioica u ocasionalmente monoica, formadora de césped. Culmos de 5 a 15 cm de longitud, estolones con entrenudos de 1 a 4 cm de longitud. Vainas estriadas, glabras o pilosas en los márgenes superiores y en la garganta. Lígula ciliada, de 0.8 a 1 mm de longitud. Láminas foliares de 6.5 a 10 cm de longitud, de 1 a 1.5(–2) mm de ancho, planas, enrolladas, escabrosas en ambas superficies. Inflo-

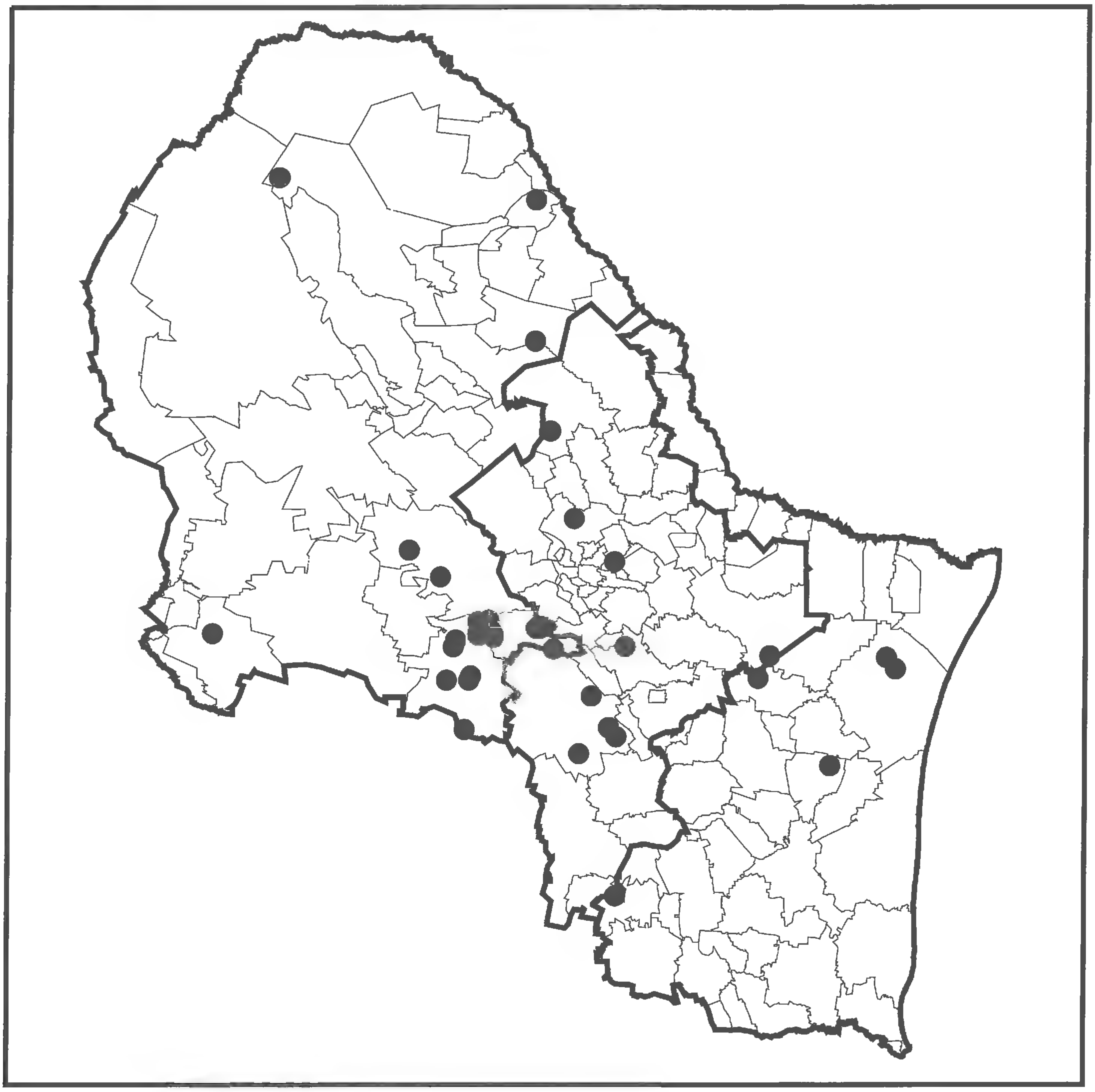


FIG. 12. Distribución de *Bouteloua dactyloides* en el noreste de México.

rescencia estaminada exserta, con 1 a 2(–4) ramificaciones primarias espigadas, de 1 a 1.5 cm de longitud. Espiguillas de 4 a 5 mm de longitud. Flores casi transparentes. Glumas subiguales de 1.5 a 4 mm de longitud, uninervadas; la segunda en ocasiones corto-aristada. Lema de 3 a 4.8 mm de longitud, con el ápice agudo y mucronado. Pálea del mismo tamaño que la lema. Anteras color naranja-rojizo o salmón. Inflorescencia femenina incluida en las 2 vainas superiores, que son cortas y ensanchadas. Ramificaciones primarias espigadas 2, de 6 a 7 mm de longitud, de 3 a 4 mm de ancho. Espiguillas color crema, pubescentes o glabras, con dientes o lóbulos en ocasiones aristados, en algunas espiguillas aristas ausentes; flores dorsalmente comprimidas. Segunda gluma cartilaginosa, con nervios poco notorios. Lema de 4 a 5 mm de longitud, levemente coriácea, lustrosa. Pálea un poco más pequeña angosta hacia el ápice, bidentada. Colectada con flores en todos los meses del año.

Distribución.—Amplia, conocida del SW de Canadá; planicies del W de EUA; N y Centro de México.

Hábitat.—Pastizales, matorrales y bosques, en la orilla de caminos; 244 a 2700 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Arteaga, Ejido La Escondida, 21 Jun 1994, 2460 m, *J.A. García 48* (MEXU); 21 Jun 1994, 2460 m, *E. Pérez 56* (MEXU); Poblado La Ciruela, 22 Jul 1993, 2600 m, *P.A. Lobato 22* (MEXU); Puerto Los Tejocotes en la Sierra de Zapalinamé, 21 Jun 1979, 2260 m, *R. López s.n.* (ANSM); Sierra de los Lirios, Jul 1942, 2600 m, *E. Lyonnet 3693* (MEXU); Sierra Hermosa, en la Sierra de Zapalinamé hacia el O rumbo al Cañón del Carbón, 8 Aug 1979, 2270 m, *R. López s.n.* (ANSM); Municipio de Muzquiz, Sierra del Carmen at Cuesta de Malena, 6 Sep 2005, 1630 m, *P.M. Peterson 18863, J. Valdés-Reyna & C. Sifuentes* (US); Municipio de Nava, Level plains of the Río Grande Valley, just N of Río Escondido, 18 km SSO of Piedras Negras on México No. 57, 12 Sep 1978, 300 m, *H.H. Iltis 21* (MEXU); Municipio de Parras, Arroyo seco en el arroyo El Tunal, 10 Aug 1984, 2000 m, *A. Rodríguez 1437, M.A. Carranza* (ANSM); Municipio de Ramos Arizpe, La Sauceda, 5 Aug 1976, 1030 m, *S. Marroquín s.n.* (ANSM); Sierra de la Paila, Ejido el Cedral por el camino El Carmen, 26 Aug 1992, 1300 m, *J. Valdés-Reyna 2163* (ANSM); Municipio de Saltillo, Sierra El Astillero, 1.8 mi SW of Santa Rosa and 5.4 mi SW of San Pedro at trail head above water pump, 21 Oct 2007, 2550 m, *P.M. Peterson 21441, J.M. Saarela & D. Stancik* (US); 12 km N of the Coahuila-Zacatecas state line along highway 54 between Saltillo-Concepción del Oro, Zacatecas, 26 Aug 1981, 1900 m, *S.L. Hatch 4514, C.W. Morden & J. Valdés-Reyna* (ANSM); 3 km S de la Ciudad de Saltillo, fracc. Parque de la Cañada, 16 Jul 1993, 1700 m, *J. Valdés-Reyna, M.A. Carranza* (ANSM); 5 km SE de la Universidad Autónoma Agraria Antonio Narro, orillas de la carretera Saltillo-Concepción del Oro, Zac., 6 Sep 1972, 1750 m, *P.E. García s.n.* (ANSM); 50 km S de Saltillo, carretera 54 a Concepción del Oro, Zacatecas, entronque El Colorado, 5 Jun 1990, 2000 m, *J.A. Villarreal 2060, J. Valdés-Reyna & M.A. Carranza* (ANSM); At Fraile, 59 km S of Saltillo. In playa valleys with considerable drainage from surrounding hills, 10 Jul 1941, 1967 m, *L.R. Stanford 271,288, K.L. Retherford & R.D. Northcraft* (MEXU); Cañón de San Lorenzo, aproximadamente 1 km E del pozo número 2, 22 Jul 1979, 1700 m, *R. López, J. Valdés-Reyna* (ANSM); Los Ramones, 20 Jul 1993, 1550 m, *E. Pérez 27* (MEXU); Rancho Los Angeles, km 30 carretera Saltillo-Concepción del Oro, Zacatecas, 31 Oct 1978, 1960 m (MEXU); Rumbo al Cañón El Cuatro, 19 Jul 1993, 1940 m, *P. Moya 422* (MEXU); Saltillo, Apr 1898, *E. Palmer 7* (MEXU); Sierra de Catana, 40 km SO de Saltillo, 29 Jul 1992, 2700 m, *J.A. Villarreal 6570, M.A. Carranza, J. Valdés-Reyna, M. Vásquez y D.E. Lozano* (ANSM); Buenavista, 1 Oct 1991, 1870 m, *Brigada Coahuila 86, 90* (MEXU); 7 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 12 Jul 1974, 1775 m, *J.F. Cano 106* (ANSM). **Nuevo León:** Municipio de Anáhuac, Distrito de Riego 04, Don Martín, 10 Abr 1985, 170 m, *P.M. De la Garza* (ANSM); Municipio de China, Rancho El Reparo, 25 Oct 1983, 150 m, *J.F. Iribe 200* (MEXU); Municipio de Doctor Arroyo, Ejido La Escondida, 5 km N carretera 102 Doctor Arroyo-Galeana, 17 Jun 1992, 1740 m, *J.A. Villarreal 6522 M.A. Carranza* (ANSM); Municipio de Galeana, Ejido 18 de Marzo, Nov 1980, 2000 m, *J.A. Ochoa 982* (MEXU); En los alrededores del poblado Santa Clara de González, 16 Jul 1993, 1940 m, *N. Bazaldua 105* (MEXU); Hacienda Pablillo, 24 Aug 1936, *M. Taylor 208* (MEXU); Sierra Madre Oriental; Pablillo about 15 mi SO of Galeana, 18 Jul 1934, 2438 m, *C.H. Mueller 1086, M.T. Mueller* (MEXU); El Salero, 19 Sep 2001, 1840 m, *P.M. Peterson 15821, J. Valdés-Reyna* (US); Municipio de Lampazos de Naranjo, Carretera a Lampazos cerca del rancho Santa Isabel, 29 Sep 1980, 370 m, *O.L. Briones 356* (ANSM); Municipio de Marín, A orillas del canal Marín, carretera Marín-Higueras a 3 km de la cabecera municipal de Marín, 1 Jul 1993, *P. Jáuregui 102* (MEXU); Municipio de Salinas Victoria, La Soledad Salinas Victoria, May 1981, 500 m, *J.A. Ochoa 1134* (MEXU). **Tamaulipas:** Municipio de Burgos, Rancho Labra, 20 Oct 1983, 150 m, *C.R. López 112* (MEXU); Municipio de Bustamante, Ejido La Cardona, 20 Oct 1982, 2050 m, *G. Villegas 560* (MEXU); Municipio de Jiménez, 11 mi N of Santander Jiménez toward San Fernando highway, 25 Nov 1959, 244 m, *M.C. Johnston 4829, J. Graham* (MEXU); Municipio de San Fernando, Ejido Palo Solo, 10 Feb 1994, 10 m, *J.F. Iribe 396* (MEXU); Rancho El Canelo, 30 May 1980, 40 m, *J.F. Iribe 2* (MEXU); Municipio de Soto la Marina, Ejido Charcos, 31 Oct 1984, *R.A. Carranco 203* (MEXU); Municipio de Tula, Joya 1, 28 Oct 1982, 1050 m, *G. Villegas 549* (MEXU).

7. Bouteloua erecta (Vasey & Hack.) Columbus, Aliso 18:63. 1999. (**Fig. 13**). *Cathestecum erectum* Vasey & Hack., Bull. Torrey Bot. Club 11:37, t. 45. 1884. Tipo: U.S.A. Texas: Bone Spring (Tornillo Cr.), between El Paso and Presidio, Aug 1883, *V. Havard 2* (lectotipo: US-884020! designado por G.J. Pierce en 1979 en la herb., validado en Contr. U.S. Natl. Herb. 41:38. 2001).

Plantas perennes. Culmos de 10 a 30 cm de alto, erectos o algo geniculados, simples o ramificados, estoloníferos, estolones delgados y correosos, entrenudos alargados y arqueados, nudos pubescentes. Vainas basales aglomeradas y pilosas en las garganta, las superiores distantes y glabras; lígula de 0.2 a 0.3 mm de largo, ciliada; láminas foliares de 2.5 a 6 cm de largo y 1 a 1.2 mm de ancho, aplanadas a veces involutas, generalmente basales, glabras a escasamente pilosas. Inflorescencia homomorfa, compuesta por 4 a 8 ramificaciones primarias espigadas, de 6 a 8 mm de largo, generalmente color verde claro, dimorfas, una forma compuesta de espiguillas estaminadas y la otra con la flor inferior pistilada o hermafrodita, la flor superior y flores de las espiguillas laterales estaminadas; espiguillas similares en una inflorescencia (monomorfas) o ambos tipos de espiguillas en la misma inflorescencia. Espiguillas estaminadas de 3 a 4 mm de largo; primera gluma 1 a 2 mm de largo, segunda gluma de 2 a 3 mm de largo, lema de 3 a 4 mm de largo, irregularmente lobuladas, sin aristas. Espiguillas pistiladas de 4.5 a 5 mm de largo, glumas 3 a 3.5 mm de largo, similares, vilosas, lema de 4 a 5 mm de largo, glabras, con una hendidura en la parte media hasta 1/3 de su longitud, con aristas híspidas emergiendo entre los lóbulos y apenas excediéndolos. Flores estaminadas laterales y superior similares a la pistilada pero de menor porte, las aristas glabras y un poco más largas que los lóbulos. Florece aparentemente de junio a noviembre.

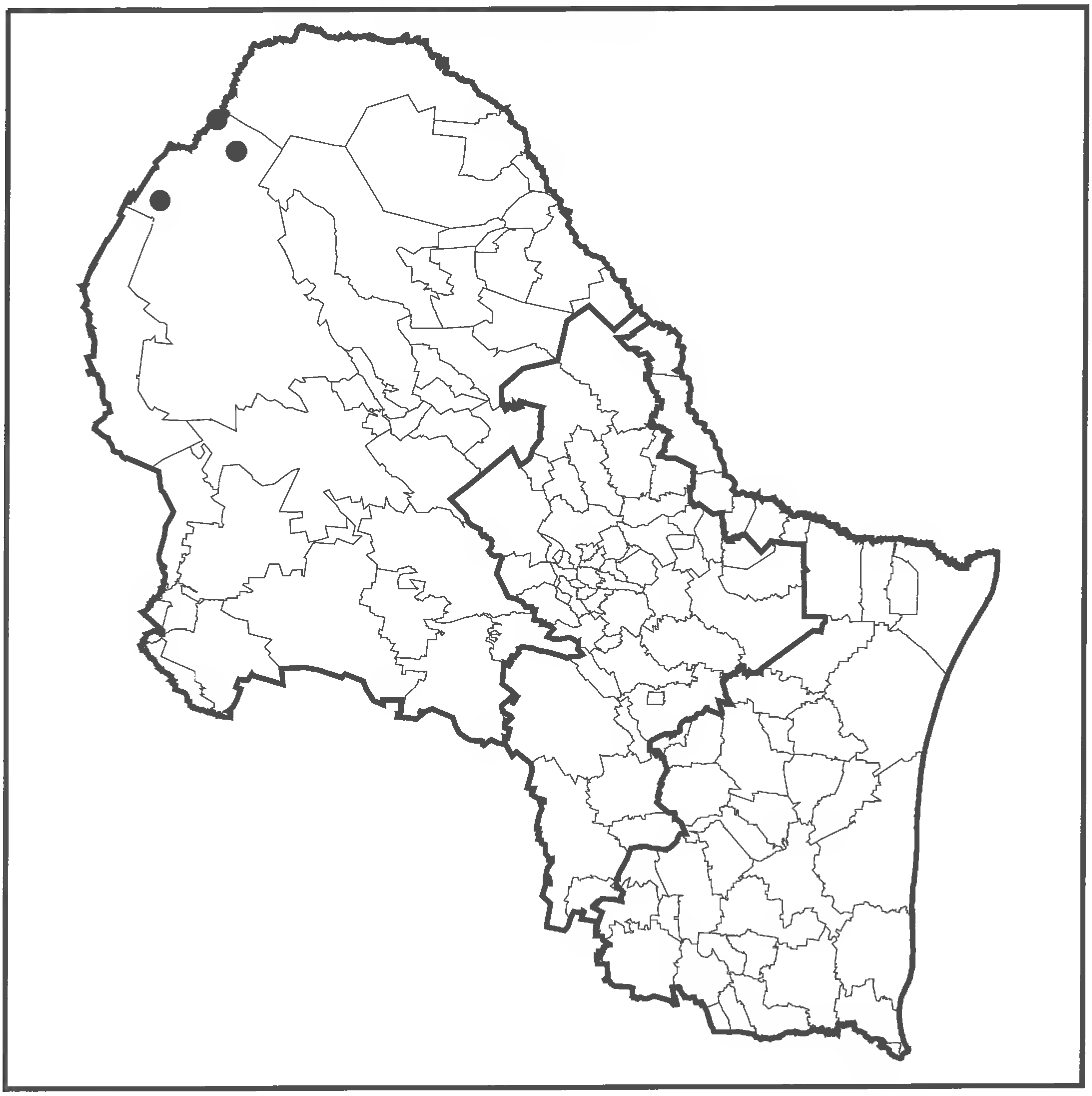


Fig. 13. Distribución de *Bouteloua erecta* en el noreste de México.

Distribución.—Desde el S de Estados Unidos a México en: Chihuahua y Coahuila.

Hábitat.—En matorral desértico micrófilo y bosque de encino; 190 a 1125 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Ocampo, Along the Río Grande, 1 km W of Boquillas de Carmen, 6 Sep 2005, 560 m, *P.M. Peterson 18872, J. Valdés-Reyna & C. Sifuentes* (US); 33.5 km S de Boquillas on the Múzquiz highway not far from the Santa Rosa turnoff, 14 Sep 1972, 960 m, *F. Chiang 9237, T.L. Wendt & M.C. Johnston* (MEXU, TEX); Hills 5 km by winding road S Rancho El Carrizal Grande, 2 Oct 1972, 1125 m, *F. Chiang 9646, T.L. Wendt & M.C. Johnston* (MEXU, TEX).

8. Bouteloua eriopoda (Torr.) Torr., Pacif. Railr. Rep. 4(5):155. 1857. (**Fig. 14**). *Chondrosum eriopodum* Torr., Not. Milit. Reconn. 153. 1848. Tipo: U.S.A. New Mexico: Las Cruces, *Wooton 458* (neotipo: US-A865571 fragm.!, designated by Gould, Ann. Missouri Bot. Gard. 66:397.1979).

Bouteloua brevifolia Buckley, Proc. Acad. Nat. Sci. Philadelphia 14:93. 1862. Tipo: U.S.A. Texas: May–Oct 1849, *C.H. Wright 748* (lectotipo: PH designado por Gould, Ann. Missouri Bot. Gard. 66:397. 1979; isolectotipo: US-81715!).

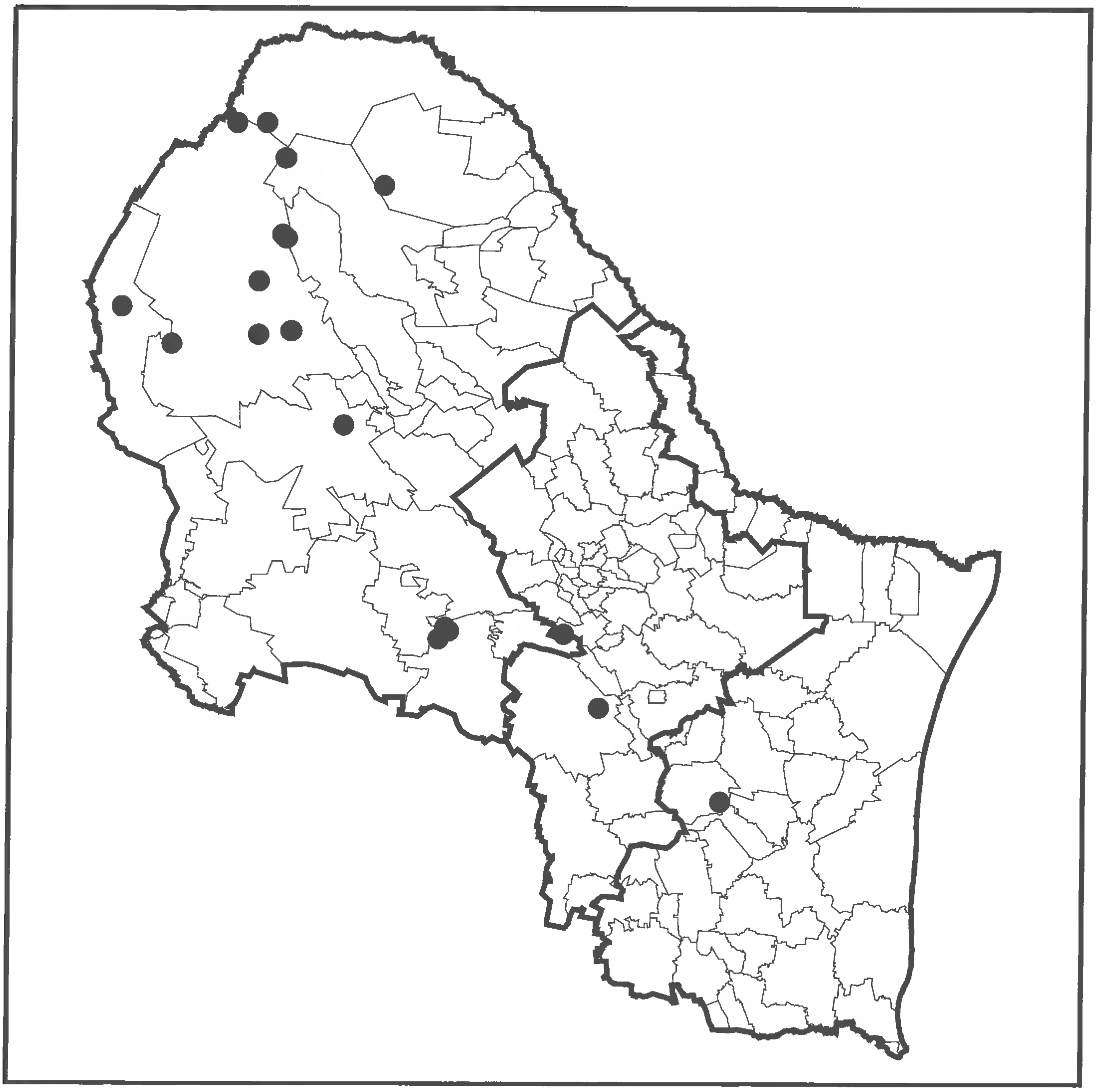


Fig. 14. Distribución de *Bouteloua eriopoda* en el noreste de México.

Plantas perennes. Culmos de 25 a 60 cm de alto, tipicamente decumbentes, estoloníferos; entrenudos de los culmos y estolones lanoso-pubescentes, al menos en parte. Vainas glabras, con márgenes hialinos, más cortos que los entrenudos; lígula de 0.2 a 0.5 mm de largo, membranácea, ciliada; láminas foliares de 2.5 a 10 cm de largo y 0.5 a 2 mm de ancho, aplanadas o involutas, con algunos pelos esparcidos principalmente en los márgenes, de 2.5 a 3 mm de largo, con bases papilosas. Inflorescencia de 5 a 10(–18) cm de largo, con 3 a 8 ramificaciones primarias espigadas persistentes, delgadas, esparcidas; ramificaciones de 2 a 5 cm de largo, portando 9 a 20 espiguillas; base del raquis de las ramas lanoso-pubescente. Espiguillas de 6 a 7 mm de largo, barbadas en la base, articulación por arriba de las glumas; glumas desiguales, agudas o acuminadas, primera gluma de 3 a 4 mm de largo, segunda gluma de 6 a 7 mm de largo, claramente glabra, con el nervio central prolongado en una arista de 1 mm de largo, emergiendo de entre 2 lóbulos agudos; lema de la flor perfecta de 6 a 7 mm de largo, barbada en la base, pubescente en el margen, estrechándose hacia el ápice, terminando en una arista fuerte de 1.5 a 3 mm de largo, las aristas laterales muy reducidas; pálea de 6 a 7 mm de largo, glabra. Anteras de 2 mm de largo, color amarillo; Flósculo rudimentario 1, lema del flósculo rudimentario de 6 a 7 mm de largo, reducida a 3 aristas aplanadas, de 4 mm de largo, barbadas en la base. Cariopsis de 2.4 a 3 mm de largo, estrechamente elíptica. $2n = 20$ (Reeder, 1967). Florece de agosto a octubre.

Distribución.—Centro y SO de Estados Unidos a México en: Coahuila, Chihuahua, Nuevo León, San Luis Potosí, Sonora, Tamaulipas y Zacatecas.

Hábitat.—Presente en pastizales y matorrales sobre mesetas arenosas secas y sitios rocosos, asociada a arbustos; 1250 a 1900 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Cuatrociénegas, 19 km al SE de Tanque Nuevo, Cuatrociénegas, *H. García s.n.* (CHAPA, ENCB, SLPM); 8 km al N de Cuatrociénegas, camino a Ocampo, *J. Marroquín 2672* (ANSM); Municipio de Muzquiz, Sierra del Carmen, Ejido San Francisco, 5 Sep 2005, 1430 m, *P.M. Peterson 18828, J. Valdés-Reyna & C. Sifuentes* (US); Municipio de Nava, Sierra El Jardín, 7.1 mi SW of Rancho La Mula, 4 Sep 2006, 1418 m, *P.M. Peterson 19963, S. Lara-Contreras* (US); Municipio de Ocampo, O base of Picacho del Fuste, NE from Tanque Vaionetta, N facing montain-side, 23 Aug 1941, *I.M. Johnston 8420* (MEXU); Rancho experimental La Rueda, 87 km NE de Ocampo, brecha Ocampo-Boquillas del Carmen, Oct 1976, 1280 m, *R. Vásquez & J.F. Sifuentes s.n.* (ANSM, ENCB, MEXU); Rancho experimental La Rueda, 87 km NE de Ocampo, brecha Ocampo-Boquillas del Carmen, 2 Jul 1991, 1350 m, *M. Vásquez s.n.* (ANSM); Rancho Santa Teresa de la Rueda, 8 Nov 1977, 1320 m, *R. Vásquez s.n.* (MEXU); Sierra La Encantada, rancho Puerto del Aire, 8 Sep 1990, 1250 m, *M.A. Carranza 730, J. Valdés-Reyna, P.A. Fryxell, R. Vásquez & O. Meza* (ANSM); Sierra La Encantada, rancho Puerto del Aire, 8 Sep 1990, 1250 m, *M.A. Carranza 768, J. Valdés-Reyna, P.A. Fryxell, R. Vásquez & O. Meza* (ANSM, MEXU, UAT); Municipio de Saltillo, 26 km O de Saltillo, carretera Saltillo-General Cepeda, ejido La Noria, 21 Jul 1983, 1780 m, *J. Valdés-Reyna 1569, L.E. Rodríguez & R. Vásquez* (ANSM); Municipio de Sierra Mojada, San Antonio de los Alamos, E base of the Volcanic Sierra de San Antonio, 20 Aug 1941, *I.M. Johnston 8251, 8257* (MEXU); Sierra de las Cruces, Sierra Mojada, *E.G. Marsh 896* (US). **Nuevo León:** Municipio de Galeana, km 3 al E de Galeana, carr., *E. Hernández & V. Mathus 1963* (ANSM). **Tamaulipas:** Municipio de Hidalgo, Estación La Cruz, 15 Nov 1976, 220 m, *G. Villegas 34, A. Bolaños* (MEXU).

9. Bouteloua eriostachya (Swallen) Reeder, Bull. Torrey Bot. Club 94:7. 1967. (**Fig. 15**). *Bouteloua eriopoda* var. *eriostachya* Swallen, Proc. Biol. Soc. Wash. 56:81. 1943. *Chondrosum eriostachyum* (Swallen) Clayton, Kew Bull. 37:418. 1982. Tipo: MÉXICO. Coahuila: cerca de Aguaje de Pajarito, 1–3 Sep 1941, *I.M. Johnston 8718* (holotipo: US-154692!; isotipos: GH, LL).

Plantas perennes, cespitosas. Culmos de 40 a 60 cm de alto, erectos, fuertes, con base nudosa; entrenudos varios, los inferiores densamente lanosos. Lígula de 0.2 a 0.6 mm de largo, un anillo densamente ciliado; láminas foliares de 4 a 10 mm de largo y 0.5 a 2 mm de ancho, aplanadas, involutas cuando secas, abundantemente híspidas en la superficie adaxial. Inflorescencia de 10 a 18 cm de largo, con 3 a 8 ramificaciones primarias espigadas esparcidas, persistentes; espigas de 2 a 5 cm de largo, portando 8 a 12 espiguillas; la rama y el raquis densamente blanco-lanoso principalmente en la base. Espiguillas de 6 a 7 mm de largo, sobre un estípite largo, articulación por arriba de las glumas; glumas desiguales, primera gluma de 2 a 3 mm de largo, glabra a escabroso-pubescente hacia el ápice, aguda a acuminada, segunda gluma de 6 a 7 mm de largo, vilosa a lanoso-pubescente, con un mucrón de 1 a 2 mm de largo; lema de la flor perfecta 5 a 6 mm de largo, esparcidamente pubescente sobre los nervios y barbada en la base, con 3 aristas, la central más larga, de 1.5 a 3 mm de largo, las laterales en ocasiones reducidas; pálea de 5 a 6 mm de largo. Flósculo rudimentario 1, lema del flósculo rudimentario con 3 aristas de 4 a 8 mm de largo, fuertes, escabrosas, barbadas en la base. Anteras de 2 a 2.2 mm de largo. Cariopsis de 2.3 a 3 mm de largo, color amarillo, lanceolado-elíptica. $2n = 60$ (Reeder, 1967). Florece de septiembre a octubre.

Distribución.—México, endémica de Coahuila.

Hábitat.—En sitios rocosos y secos con matorral espinoso y planicies; 800 a 1200 m.

Ejemplares examinados. **MÉXICO: Coahuila.** Municipio de Cuatrociénegas, 19 mi SW of Cuatrociénegas, 6 Sep 1965, 1300 m, *J.R. Reeder & C.G. Reeder 4522* (US); Carretera Cuatrociénegas - San Pedro de las Colonias, 17 Sep 1996, 800 m, *J.T. Columbus 2843, M. Porter* (ANSM); Municipio de Ocampo, Sierra de las Cruces, E foothills 8 mi N of Santa Elena Mines, *Johnston & Muller 1021* (MEXU); Municipio de San Pedro, 5.5 km al NW de Nueva Delicias, vertiente E de la Sierra de las Delicias, al N de San Pedro de las Colonias, *Y. Herrera Arrieta 1491, M. de la Cerda & O. Rosales* (CIIDIR, HUAA); Municipio de Sierra Mojada, San Antonio de los Alamos, E base of the Sierra San Antonio, *Johnston 8257* (MEXU).

10. Bouteloua gracilis (Kunth) Lag. ex Griffiths, Contr. U.S. Natl. Herb. 14:375. 1912. (**Fig. 16**). *Chondrosum gracile* Kunth, Nov. Gen. Sp. (quarto ed.) 1:176, pl. 58. 1816. *Actinochloa gracilis* (Kunth) Willd. ex Roem. & Schult., Syst. Veg. 2:418.

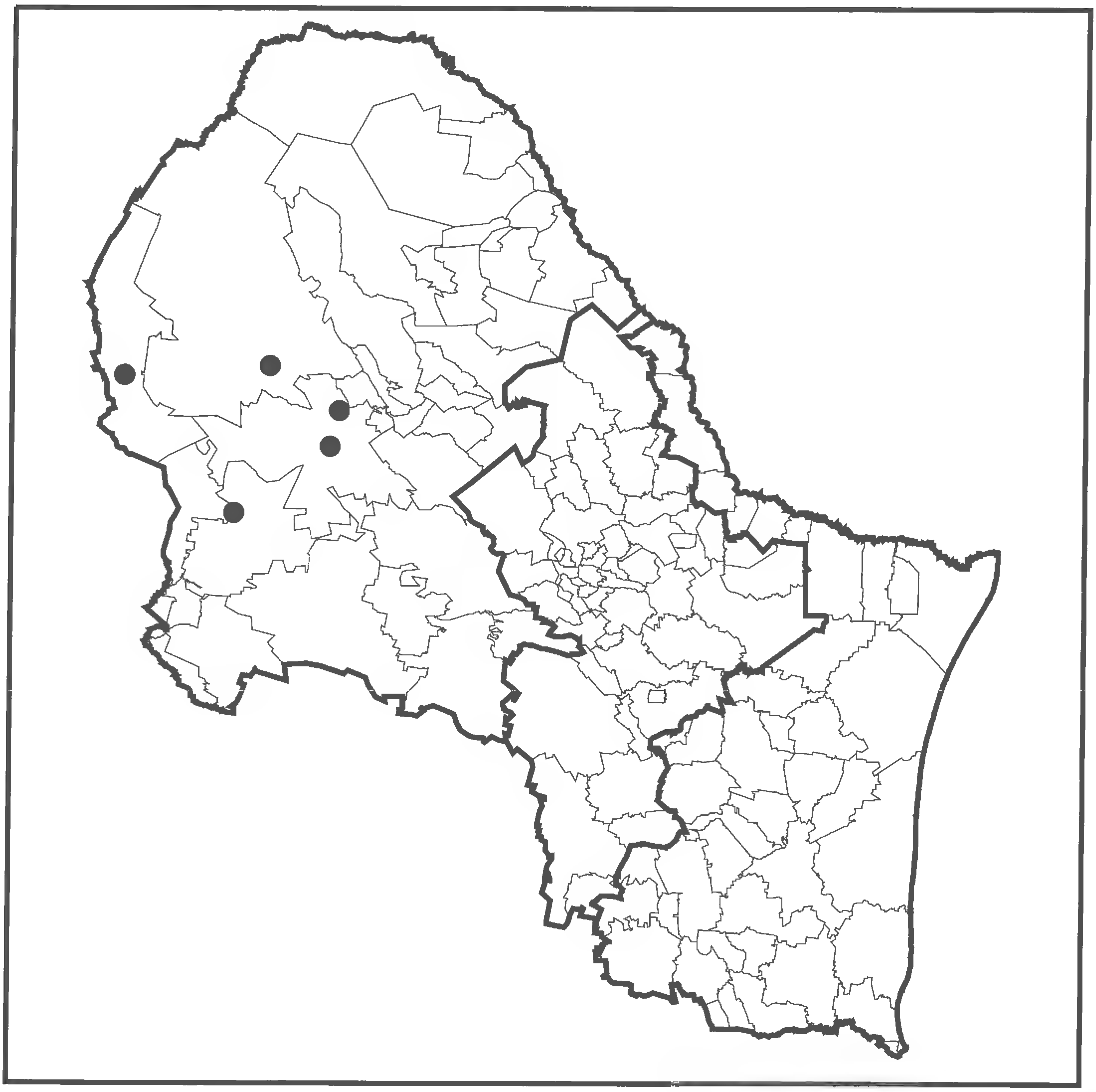


Fig. 15. Distribución de *Bouteloua eriostachya* en el noreste de México.

1817. *Eutriana gracilis* (Kunth) Trin., Gram. Unifl. Sesquifl. 240. 1824. *Atheropogon gracilis* (Kunth) Spreng., Syst. Veg. 1:293. 1824. Tipo: MÉXICO. Guanajuato: La Bufa, Sep, *F. Humboldt & A. Bonpland s.n.* (holotipo: B-W1628; isotipo: US-A865679 fragm.!).

Atheropogon oligostachyus Nutt., Gen. N. Amer. Pl. 1:78. 1818. *Eutriana oligostachya* (Nutt.) Kunth, Revis. Gramin. 1:96. 1829. *Chondrosum oligostachyum* (Nutt.) Torr., Explor. Red River Louisiana 300. 1853. *Bouteloua oligostachya* (Nutt.) Torr. ex A. Gray, Manual (ed. 2) 553. 1856. Tipo: U.S.A.: Plains of the upper Missouri, *T. Nuttall s.n.* (holotipo: BM; isotipo: PH!).

Chondrosum gracile var. *polystachyum* Nees, Linnaea 19(6):692. 1847. Tipo: MÉXICO. *Aschenborn 153* (holotipo: ?; isotipo: US-883615 fragm.!).

Bouteloua stricta Vasey, Bull. Torrey Bot. Club15(2):49. 1888. *Bouteloua gracilis* var. *stricta* (Vasey) Hitchc., J. Wash. Acad. Sci. 23(10):454. 1933. Tipo: U.S.A. Texas: western Texas, 1887, *G.C. Nealley s.n.* (holotipo: US-81710!).

Bouteloua oligostachya var. *major* Vasey ex L.H. Dewey, Contr. U.S. Natl. Herb. 2(3):531. 1894. *Bouteloua gracilis* var. *major* (Vasey ex L.H. Dewey) Beetle, Phytologia 52(1):11. 1982. Tipo: U.S.A. Arizona: 1882, *J.G. Lemmon 427* (holotipo: US-883201!).

Bouteloua oligostachya var. *pallida* Scribn. ex Beal, Grass. N. Amer. 2:418. 1896. *Bouteloua gracilis* forma *pallida* (Scribn. ex Beal) B. Boivin, Naturaliste Canad. 94(4):521. 1967. Tipo: MÉXICO. Chihuahua: 23 Aug 1885, *C.G. Pringle 407* (holotipo: US-81708!).

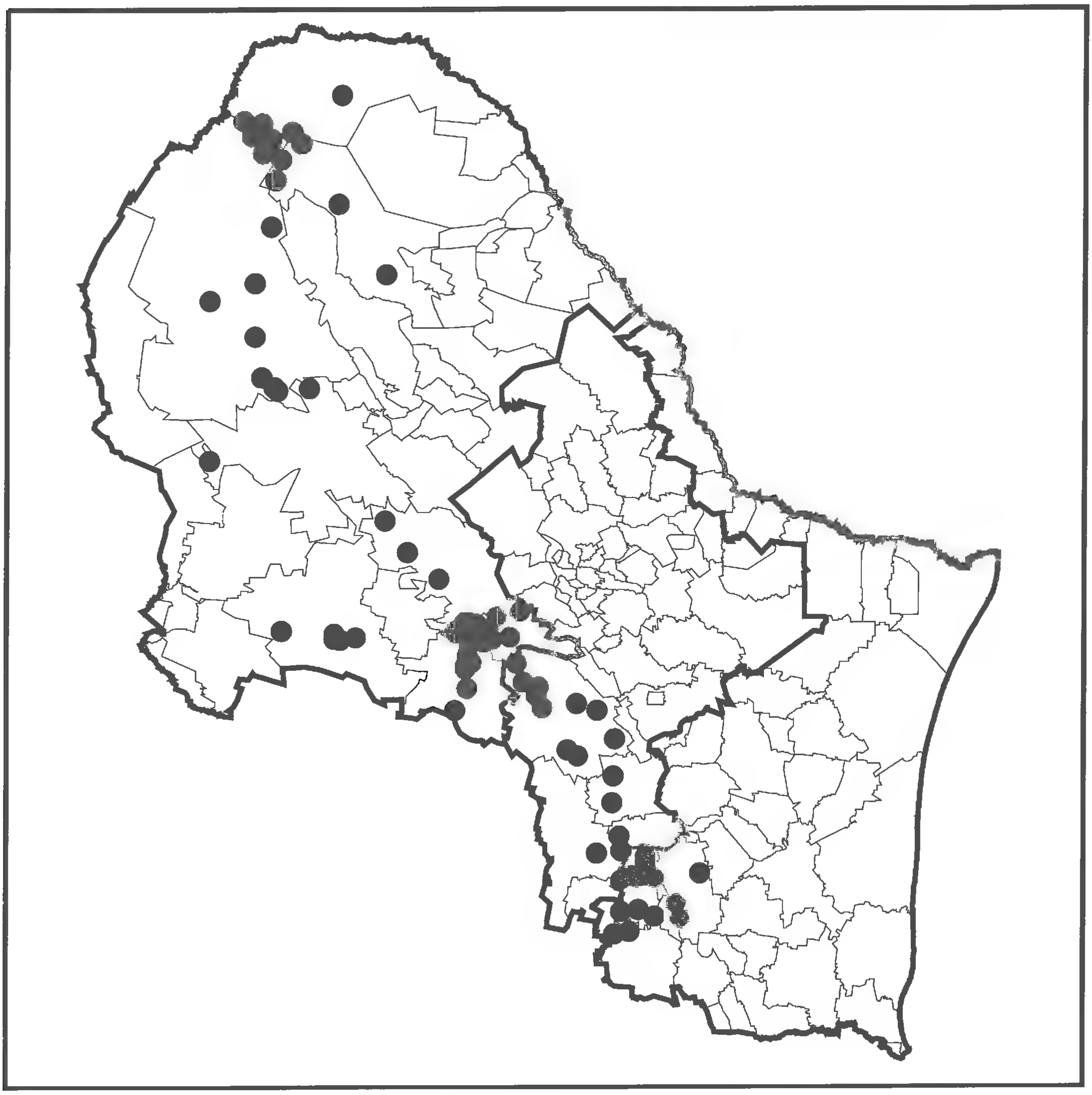


Fig. 16. Distribución de *Bouteloua gracilis* en el noreste de México.

Plantas perennes, amacolladas. Culmos de 20 a 70 cm de alto; nudos 1 a 2 (3), glabros, ligeramente geniculados en ocasiones, nunca ramificados arriba de la base; entrenudos glabros. Vainas glabras, más cortas que los entrenudos; lígula de 0.3 a 0.5 mm de largo, membranácea, ciliada; láminas foliares de 5 a 15(–30) cm de largo y 1 a 2.5 mm de ancho, membranáceas. Inflorescencia de 2.5 a 5(–7) cm de largo, con (1) 2 (4) ramificaciones primarias espigadas persistentes; ramificaciones densas de (1.5)3 a 4.5 cm de largo y 4 a 7 mm de ancho, lineares, conspicuamente pectinadas, portando 40 a 100 espiguillas, distribuidas hasta el ápice del raquis; raquis piloso o híspido, aplanado, recto, no arqueado. Espiguillas de 5 a 6.5 mm de largo, color verde cambiando a púrpura obscuro en la madurez, articulación por arriba de las glumas; glumas desiguales, primera gluma de 2 a 3 mm de largo, glabra, segunda gluma de 5 a 6.5 mm de largo, apiculada, no-mucronada, usualmente esparcido pilosa o híspida, a menudo piloso-papilosa, pelos de 2 a 3 mm de largo, en ocasiones no-pilosa pero con pubescencia corta y densa en los extremos, ocasionalmente con tubérclos purpúreos en la madurez; lema de la flor perfecta de 4 a 5.5 mm de largo, con 3 aristas de 1 a 3 mm de largo, barbada en la base y pilosa en las nervaduras, al menos la central, los pelos de 0.5 a 0.8 mm de largo; pálea de 4 a 5.5 mm de largo, glabra. Flósculos rudimentarios 1 a 2, lema de la primera de 3.5 a 5.5 mm de largo incluyendo las aristas, 3-aristada, con un mechón de pelos en la base del estípite; el segundo flósculo cuando presente en forma de escama, de 2.5 a 3 mm de largo y ca.0.5 mm de ancho. Anteras de 2.2 a 2.5 mm de largo, color amarillo. Cariopsis de 2 a 2.2 mm de largo, color amarillo a amarillo-verdosa, angulosa triangular. $2n$ = 20, 40, 60. Florece de julio a noviembre.

Distribución.—Ampliamente distribuída en Canadá, Estados Unidos y México.

Hábitat.—Principal elemento de los pastizales naturales de SW de EUA y NW de México. Se le reconoce su excelente calidad forrajera; 1100 a 2600 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Acuña, 2 km N of El Conejo on the winding road to La Huerfanita, 13 Sep 1972, 1100 m, *F. Chiang 9191, T.L. Wendt & M.C. Johnston* (MEXU); Del Carmen mountains, 29 Aug 1936, *E.G. Marsh Jr. 570, 693* (MEXU); Municipio de Arteaga, Al N de la cañada el Columpio, aprox. 2 km NO del Ejido Sierra Hermosa, 19 Oct 1979, 2270 m, *R. López s.n.* (ANSM); Predio El Cristal, 21 Jun 1994, 2100 m, *J.A. García 53* (MEXU); Municipio de Cuatrociénegas, Cañón de la Carretera, Sierra de la Madera, along the road up the open main canyon, 16 Sep 1941, 1280 m, *I.M. Johnston 9159* (MEXU, US); Municipio de Francisco I. Madero, Valle de Buenavista, a broad high montane valley enclosed by the Sierra de los Organos (to NO), S de los Remedios (S de Acatita, to SO), and S de las Margaritas (to E); NO of Valle del Sobaco, 30 Aug 1975, 1575 m, *T.L. Wendt 1387-C, E.J. Lott* (MEXU); Municipio de General Cepeda, km13 al W de Saltillo, *E. Hernández & V. Mathus N-1665* (US); *E. Hernández & V. Mathus 1776* (ANSM); 20 km O de Saltillo, carretera Saltillo-Torreón, 6 Nov 1972, 1400 m, *R. Almeida 1639* (ANSM); 6 mi O of Saltillo along highway 40 toward Torreón, 25 Aug 1983, 1700 m, *S.L. Hatch 5037, J. Valdés-Reyna* (ANSM); Municipio de Múzquiz, 99.6 mi N of Melchor Muzquiz at Cuesta de malena on Hwy 25 towards Bequillas del Carmen, 01 Sep 2006, 1574 m, *P.M. Peterson 19829, S. Lara-Contreras* (US); 20 mi NW de Hacienda la Baba, Múzquiz, *F. Wynd & C.H. Mueller 435* (MEXU, US); La Cuesta del Plomo on the Múzquiz-Boquillas highway, 14 Sep 1972, 1750 m, *F. Chiang 9203, T.L. Wendt & M.C. Johnston* (MEXU); Sierra del Carmen, Ejido San Francisco, 5 Sep 2005, 1430 m, *P.M. Peterson 18837, J. Valdés-Reyna & C. Sifuentes* (US); Sierra del Carmén, Campo 1, 12 Aug 1975, 1800 m, *M.F. Robert 5311,5553, J. Passini* (ANSM); Sierra Maderas del Carmen, 17 Sep 1989, 1800 m, *E.A. Estrada 1837* (ANSM); Madera del Carmen, 11.2 mi NE of Los Pilares, 21 Sep 2007, 1953 m, *P.M. Peterson 20950, J.M. Saarela, S. Lara-Contreras & J. Reyna* (US); Madera del Carmen, 16.3 mi NE of Los Pilares on road towards Campo Dos, 21 Sep 2007, 2235 m, *P.M. Peterson 20993, J.M. Saarela, S. Lara-Contreras & J. Reyna* (US); Municipio de Nava, Sierra El Jardín, Canyon del Diablo, 8 mi from jct of road towards Boquillas, 2 Sep 2006, 1336 m, *P.M. Peterson 19865, S. Lara-Contreras* (US); Sierra El Jardín, slopes above Canyon del Diablo, 2 Sep 2006, 1418 m, *P.M. Peterson 19883, S. Lara-Contreras* (US); Sierra El Jardín, 4 Sep 2006, 1480 m, *P.M. Peterson 19945, S. Lara-Contreras* (US); Sierra El Jardín, 8 mi SW of Rancho La Mula, 4 Sep 2006, 1394 m, *P.M. Peterson 19958, S. Lara-Contreras* (US); Municipio de Ocampo, Madera del Carmen, 9.7 mi NE of Los pilares, 21 Sep 2007, 1902 m, *P.M. Peterson 20936, J.M. Saarela, S. Lara-Contreras & J. Reyna* (US); 2 km O of Santa Elena, foothills of the Sierra de las Cruces, 18 Jul 1941, *R.M. Stewart 831* (MEXU); Sierra El Pino, 9.2 km SW of Rancho El Cimarron along the easter slopes, 14 Sep 1991, 1500 m, *P.M. Peterson 10626, & C.R. Annable* (US); Sierra El Pino, 33.5 kmW of Rancho El Cimarron, 14 Sep 1991, 1500 m, *P.M. Peterson 10691, & C.R. Annable* (US); Base of hills in palma-belt, near mouth of Cañón de la Cruz, about 20 km S of Ocampo, 16 Sep 1941, *I.M. Johnston 9177* (MEXU); Rancho La Rueda, 92 km al NW de Villa Ocampo, *M. Vázquez s.n.* (SLPM); Between Palos Blancos and San Pedro, road from Ocampo over the mountains to Puertecito (via cuesta de Zozaya), 19 Sep 1941, *I.M. Johnston 9274* (MEXU); Mesa Grande, high mesas 40 km NO of Hacienda de La Encantada, 14 Sep 1941, *R.M. Stewart 1632* (MEXU); O base of Picacho del Fuste, NE from Tanque Vaionetta, N facing montain-side, 23 Aug 1941, *I.M. Johnston 8424* (MEXU); Rancho experimental La Rueda, 87 km NE de Ocampo, brecha Ocampo-Boquillas del Carmen, Sep 1976, 1530 m, *R. Vásquez s.n.* (ANSM); Rancho experimental La Rueda, 87 km NE de Ocampo, brecha Ocampo-Boquillas del Carmen, 1 Jul 1991, 1350 m, *M. Vásquez s.n.* (ANSM); Rancho Santa Teresa de la Rueda, Sep 1976, 1530 m, *R. Vásquez* (MEXU); Municipio de Parras, Cañón de Gustrola, 16 km al SE de Parras de la Fuente, 30 Ene 1981, 2000 m, *A. Rodríguez 185* (ANSM); *J. Valdés-Reyna s.n.* (SLPM); *A. Orta & M. Carranza 13304* (UAG); Rancho el Tunal, 25 km ESE de Parras de la Fuente, 5 Jul 1983, 2050 m, *A. Rodríguez 1179, M.A. Carranza* (ANSM); Municipio de Parras, Sierra de Parras en el arroyo La Tinaja, 13 Sep 1980, 1850 m, *A. Rodríguez 254, M. Martínez* (ANSM); Municipio de Ramos Arizpe, La Sauceda, 5 Aug 1976, 1030 m, *J.S.Marroquín s.n.* (ANSM); San Juan de las Bonitas, 19 Jul 1993, 1450 m, *F. Alcalá 15* (MEXU); Santa Fé de los Landeros, 19 Jul 1993, 1450 m, *E. Pérez 21* (MEXU); Sierra de la Paila (Lado Norte) Cañada Becerros, 13 Oct 1989, 1700 m, *J.A. Villarreal 5433, M.A. Carranza & L. Arce* (ANSM); Ejido el Cedral por el camino El Carmen, 4 Oct 1989, 1300 m, *J.A. Villarreal 5332, M.A. Carranza & A. Rodríguez* (ANSM); Municipio de Saltillo, 0n highway 54 (road to Concepción del Oro), 6 km S de Saltillo, reforestation area Zapalinamé, near Universidad Autónoma Agraria Antonio Narro, 18 Sep 1988, 1800 m, *M.E. Barkworth 5112, P.S. Hoge, J. Valdés-Reyna-Reyna & M. A. Carranza P.* (ANSM); 29 km S of Saltillo on Mex 54 and 2.1 km W on road to Microondas, just W of Estacion, 18 Oct 1989, 2250 m, *P.M. Peterson 8414, M.A. Carranza* (US); La Angostura, Saltillo, *M. Tórres 1589* (ANSM); 29 km al S de Saltillo, carr. Saltillo-Zacatecas, *R. Almeida 1630* (ANSM); Sierra Zapalinamé, Loma de Lourdes, *R. Palomo s.n.* (ANSM); Area del Rastro, 7 km S de Saltillo, 3 Aug 1973, 1800 m, *R. Banda 2599* (ANSM); Saltillo, 0.3 km E of Hwy to Zacatecas up to road to San Lorenzo, 10 Sep 1990, 1720 m, *P.M. Peterson 10553, C.R. Annable* (US); Buenavista, 7 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 23 Nov 1975, 1600 m, *A. Aznar s.n.* (ANSM); 20 May 1986, 1785 m, *E. García s.n.* (ANSM, ENCB, IBUG, IEB); 8 Aug 1974, 1800 m, *A. Rodríguez 131* (ANSM); Cañada Salsipuedes, en la Sierra Zapalinamé, 3 km NO de Cuauhtémoc, 28 Sep 1979, 2450 m, *R. López s.n.* (ANSM); Intermediaciones de la Sierra de Zapalinamé, SE de Saltillo, 26 Aug 1986, 1800 m, *J. Espinosa 28* (ANSM); La Encantada, 19 Sep 1991, 1860 m, *Brigada Coahuila 217, 220, 221, 231, 234, 235* (MEXU); Paso de Carneros, al S de Saltillo, 14 Nov 1974, 1100 m, *J.S. Marroquín 3059* (ANSM); Rancho experimental Los Angeles, 48 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 15 Jul 1981, 1800 m, *M.A. Carranza, M. T. Ruíz de León & M. Vásquez R.* (ANSM); 25 Jul 1972, 1800 m, *P.E. García s.n.* (ANSM); 26 Aug 1981, 1900 m, *S.L. Hatch 4536, C.W. Morden & J. Valdés-Reyna* (ANSM); 1 Jul 1974, 1725 m, *R.E. Rodríguez 108* (ANSM); 1 Sep 1978, 2000 m, *J.S. Sierra s.n.* (ANSM); Jul 1976, 2200 m, *R. Vásquez s.n.* (ANSM); 14 Sep 1992, *J.A. Villarreal 6716, M.A. Carranza & D.E. Lozano* (ANSM); Rastro de Saltillo, 7 km S de Saltillo, 7 Jul 1972, 1780 m, *R. Almeida 1383* (ANSM); 5 mi W of Chapultepec on cutoff road between Hwy 54 & 57, 23 mi S of Saltillo, 16 ct 1995, 2410 m, *P.M. Peterson 13270, M.B. Knowles* (US); Sierra de Zapalinamé. Lomas de Lourdes, 9 Sep 1975, 1770 m, *R. Palomo s.n.* (ANSM). **Nuevo León:** Municipio de Aramberri, 16 km NE of Sandia on road to La Ascension, 19 Sep 2001, 2000 m, *P.M. Peterson 15828, J. Valdés-Reyna* (US); 7.5 km E of Puentes on dirt road, 19 Sep 2003, 1775 m, *P.M. Peterson 17849, J. Valdés-Reyna & H.S. Hinton* (US); Municipio de Bustamante, 10 km al NE de la Verdolaga, 5 Jul 1985, 1800 m, *P. Hiriart* 849, *R. Molczadzki & V. Juárez* (MEXU); Municipio de Dr. Arroyo, 9.4 mi W of San Antonio de Peña Nevada & 0.4 mi E of jct of Hwy 2 to Or., 22 Sep 2002, 1807 m, *P.M. Peterson 16796, J. Valdés-Reyna & M. Sosa* (US); 30 km ENE of Dr. Arroyo, ENE of San Antonio de Peña Nevada, O base of Cerro Peña Nevada, 30 Jul 1989, 1950 m, *G. Lane 4731* (ANSM); Doctor Arroyo, Nov 1980, 1700 m, *J.A. Ochoa 1189* (MEXU); Municipio de Galeana, 12.3 mi S of Milagro, 18 Sep 2003, 2040 m, *P.M. Peterson 17808, 17811, J. Valdés-Reyna & H.S. Hinton* (US); 5.1 mi S of Milagro, 18 Sep 2003, 2000 m, *P.M. Peterson 17818, J. Valdés-Reyna & H.S. Hinton* (US); Arroyo Hondo, Hacienda San José de Raices, 1 Aug 1935, *C.H. Mueller 2310* (MEXU); 6.5 mi S of border of Coahuila and Nuevo León on Hwy 57 towards Matehuala, 16 Oct 1995, 1920 m, *P.M. Peterson 13288, M.B. Knowles* (US); El Salero, 19 Sep 2001, 1840 m, *P.M. Peterson 158823, J. Valdés-Reyna* (US); Hacienda Pablillo, 5 Aug 1936, *M. Taylor 56* (MEXU); Navidad, carretera 57, km 85 al N de Saltillo, 23 Sep 1978, 1650 m, *F. Cárdenas, M.A. Bernal* (MEXU); Rancho Aguililla, 17 Oct 1989, 1950 m, *G.B. Hinton 19861* (MEXU); Valle de Santa Rita, Galeana, *I. Siller 10858* (UAG). **Tamaulipas:** Municipio de Bustamante, Camino a la Joya de San Francisco, 1950 m, *A. Brito* (MEXU); Municipio de Jaumave, 1 km N del ejido San Antonio, 10 Nov 1989, 680 m, *A. Mora 1320* (UAT); Municipio de Miquihuana, 4 kmN del ejido estanque de los Walle, 29 May 1986, 1560 m, *L. Hernández 1841* (UAT); 3 Sep 1981, 2460 m, *R.A. Carranco 78* (MEXU); 4 kmO of Miquihuana, 4 Aug 1941, 2600 m, *L.R. Stanford 647, K.L. Retherford & R.D. Northcraft* (MEXU); 6 km al O de Miquihuana, 6 Jul 1985, 2130 m, *P. Hiriart 873, V. Juárez, R. Molczadzki, J.L. López, F. Ojeda & J.A. Gutíerrez* (MEXU); 9 km al O de Miquihuana, 20 Sep 1984, 1560 m, *P. Hiriart 338, V. Juárez* (UAT); El Cargadero, 15 km O del estanque de los Walle, 25 Oct 1986, 1560 m, *L. Hernández 2055* (UAT); La Peña, 8 Dic 1988, 2000 m, *M. Cisneros 198* (MEXU); Rumbo al Aserradero, 4 Sep 1981, 1900 m, *R.A. Carranco 72* (MEXU); San José del Llano, 29 Nov 1984, *J.F. Iribe 231* (MEXU); Valle Hermoso, 13 Aug 1977, 2000 m, *G. Villegas 84, M.A. Bolaños* (MEXU); Municipio de Palmillas, 13.5 km al NO de Palmillas, 7 Jul 1985, 1600 m, *P. Hiriart 904, V. Juárez* & *R. Molczadzki* (MEXU); 101.6 kmSWof Ciudad Victoria on Mex 101 towards San Luis Potosí, 9 ct 1989, 1720 m, *P.M. Peterson 8314 & R.M. King* (US); Municipio de Tula, 30 km al N de Tula, 25 Aug 1983, *I. Nuñez 30* (MEXU); 5 km al O del Ejido El Salitrillo, 3 Jul 1983, 1500 m, *P. Hiriart 761, V. Juárez, R. Molczadzki, J.L. López, F. Ojeda & J.A. Gutíerrez* (MEXU); La Tapona, 21 Oct 1982, 1900 m, *M.H. Cervera 134, 134-B* (MEXU).

11. Bouteloua hirsuta Lag., Varied. Ci. 2(4):141. 1805. *Actinochloa hirsuta* (Lag.) Roem. & Schult., Syst. Veg. 2:419. 1817. *Chondrosum hirsutum* (Lag.) Sweet, Hort. Brit. 1:455. 1826. Tipo: MÉXICO: cultivated in Madrid from seed, *Lagasca s.n.* (lectotipo: MA-245716 designado por Griffiths, Contr. U.S. Natl. Herb. 14:372, 1912; isolectotipos: BM, M-7433 LE-TRIN 2125.6 fragm. ex M!).

Planta perenne, de vida corta o larga, ocasionalmente estoloníferas. Culmos de 15 a 75 cm de alto, moderadamente ramificados o sin ramificar, con 3 a 6 nudos glabros a densamente híspidos con pelos de base papilosa, erectos o decumbentes en la base. Hojas basales y caulinares; vainas glabras a papiloso-hirsutas, más cortas que los entrenudos; lígula corto ciliada de 0.1 a 0.5 mm de largo; láminas foliares de 5 a 18(–30) cm de largo y 1 a 2 mm de ancho, aplanadas o subinvolutas, casi glabras a hirsuto-pubescentes en la superficie adaxial, con pelos papilosos en el margen y parte basal de la hoja. Inflorescencia de 10 a 40 cm de largo; ramificaciones primarias espigadas 1 a 5, de 1.5 a 4 cm de largo y 6 a 9 mm de ancho, pectinadas, persistentes, portando (10–)20 a 50 espiguillas, subsésiles, con el raquis conspicuamente aplanado, proyectándose 5 a 10 mm más allá de la inserción de la espiguilla distal, terminando en una aguja semirígida. Espiguillas de 4 a 6.5(–7) mm de largo, color verde o púrpura oscuro, articulación por arriba de las glumas; glumas desiguales, lanceoladas, terminando en una arista de 1 a 3 mm de largo, primera gluma de 1.5 a 2.5(–3) mm de largo, angosta, híspida a lo largo de la nervadura media, segunda gluma de 3 a 6(–6.5) mm de largo, papiloso-hirsuta a lo largo de la nervadura media, las papilas negras, los pelos hasta de 2 mm de largo; lema de la flor perfecta de 4 a 6 mm de largo, 3-dentada, cada diente termina en una pequeña arista de 1 mm de largo, conspicuamente pilosa a lo largo de los márgenes y de la nervadura central; pálea de 3.5 a 4.2 mm de largo, ovada, obtusa, pubescente, sin nervaduras visibles. Anteras de 2 a 2.5(–3) mm de largo, color amarillo a crema. Flósculos rudimentarios 2 a 3, el primero con la lema de 2 a 5 mm de largo, 2-lobulada y 3-aristada, aristas híspidas, de 3 a 4(–6) mm de largo, los otros flósculos reducidos a brácteas diminutas, a veces hasta de 0.5 mm de largo; raquilla de 1 a 2 mm de ancho. Cariopsis de 0.7 a 2 mm de largo, color amarillo, anguloso-triangular. 2*n* = 20, 60.

Bouteloua hirsuta Lag. var. **hirsuta** (**Fig. 17**). *Chondrosum hirtum* Kunth, Nov. Gen. Sp. (quarto ed.) 1:176, t. 59. 1816. *Atheropogon hirtus* (Kunth) Spreng., Syst. Veg. 1:293. 1825. *Bouteloua hirta* (Kunth) Scribn., Contr. U.S. Natl. Herb. 2(3):531. 1894. Tipo: MÉXICO: *F. Humboldt & A. Bonpland s.n.* (holotipo: P; isotipo: B-W-1626, M, LE-TRIN-2126.1!, US-A865681 fragm.!).

Atheropogon papillosus Engelm., Amer. J. Sci. 46:104. 1843. *Bouteloua pappilosa* (Engelm.) Torr., Explor. Red River Louisiana 300. 1853. *Chondrosum papillosum* (Engelm.) Torr., Explor. Red River Louisiana 300. 1853. Tipo: U.S.A. Illinois. Cass Co.: 1842, *Geyer s.n.* (holotipo: MO!).

Chondrosum aschenbornianum Nees, Linnaea 19(6):692. 1847. *Bouteloua aschenborniana* (Nees) Griseb. ex E. Fourn., Mexic. Pl. 2:137. 1886. Tipo: MÉXICO: *A. Aschenborn 331* (holotipo: B; isotipo: US-865680 fragm.!).

Chondrosium foeneum Torr., Not. Milit. Reconn.153, pl. 12. 1848. *Bouteloua foenea* (Torr.) Torr. ex S. Watson, Cat. Pl. 18. 1874. Tipo: U.S.A. New Mexico: Cooks Springs, 9 Oct 1846, *W.H. Emory s.n.*(lectotipo, designado aquí: NY-73939!).

Chondrosium drummondii E. Fourn. Mexic. Pl. 2:137. 1886. Tipo: U.S.A. Texas: *Drummond 323* (lectotipo, designado aquí: P!; isolectotipos: LE, US-A865677 fragm. ex P!, US-2182917 fragm.!, US-1063203 fragm. ex E!).

Bouteloua hirsuta var. *palmeri* Vasey ex Beal, Grass. N. Amer. 2:417. 1896. Tipo: MÉXICO: cultivated from seed, 1886, *E. Palmer s.n.* (holotipo: US!).

Culmos 15 a 40 cm de alto, decumbentes en la base, usualmente ramificados arriba de la base, con 4 a 6 nudos; entrenudos glabros. Hojas generalmente caulinares; vainas glabras o papiloso-hirsutas, pilosas en la garganta; láminas foliares de 5 a 18 cm de largo y 1 a 2 mm de ancho, aplanadas a subinvolutas. Inflorescencias de 10 a 30 cm de largo; ramificaciones primarias espigadas 1 a 4, de 1.5 a 3 cm de largo, persistentes, portando 20 a 40 espiguillas, subsésiles; con el raquis aplanado, proyectándose hacia adelante de la espiga terminal. Anteras de 2 a 2.5 mm de largo. Cariopsis de 0.7 a 1.5(–2) mm de largo. Colectada con flor todo el año.

Distribución.—Ampliamente distribuida en Estados Unidos y México.

Hábitat.—Se le encuentra en áreas planas con pastizales abiertos y secos, con matorrales y/o bosque de encino y en suelos bien drenados, rocosos; 50 a 2300 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Acuña, Del Carmen mountains, 9 Ene 1936, *E.G. Marsh Jr. 887* (MEXU); Serranías del Burro, rancho El Bonito, cañón Los Ojitos, 19 Sep 1977, 1600 m, *D.H. Riskind 2181* (ANSM); Municipio de Allende, 135.4 km NW of Muzquiz on Hwy 53 towards Boquilla del Carmen, 12 Sep 1991, 1380 m, *P.M. Peterson 10578, C.R. Annable* (US); Municipio de Arteaga, Al N de la cañada el Columpio, aprox. 2 km NO del Ejido Sierra Hermosa, 19 Oct 1979, 2260 m, *R. López s.n.* (ANSM); *S.L. Hatch, C.W. Morden & J. Valdés-Reyna 4535* (ANSM); La 'Herradura,' carretera Saltillo-Matehuala, Sierra de Arteaga, 7 Oct 1973, 2020 m, *R. García s.n.* (ANSM); Sierra Hermosa, en la Sierra de Zapalinamé hacia el O rumbo al Cañón del Carbón, 8 Aug 1979, 2300 m, *R. López s.n.* (ANSM); Municipio de Castaños, La Muralla, Sierra de la Gavia, carretera 57, 7 Oct 1989, 1400 m, *A. Rodríguez 1301, M. Martínez & J.M. Sosa* (ANSM); 15 mi S of Castaños, *J.R. Reeder & C.G. Reeeder 3951* (US); Municipio de Cuatrociénegas, Sierra de la Madera, vicinity of 'La Cueva' in Corte Blanco fork of Charretera Canyon, 11 Sep 1941, 1615 m, *I.M. Johnston 9058* (MEXU); Sierra Las Cautivas, 23.4 mi W of Ejido Guayabas along road towards Dulces Nombres, 25 Sep 2007, 1882 m, *P.M. Peterson 21063, J.M. Saarela* (US); Municipio de Monclova, Sierra de la Gloria, in Cañón del Chilpitín, 5 mi up (E) from mouth of canyon, near El Chilpitín, at jct of main canyon, 7 Sep 1976, 1060 m, *T.L. Wendt 1685, D.H. Riskind* (MEXU); Municipio de Múzquiz, Sierra del Carmen, Ejido San Francisco, 5 Sep 2005, 1430 m, *P.M. Peterson 18836, J. Valdés-Reyna & C. Sifuentes* (US); Sierra del Carmen, flancos E camino al rancho las Norias, 17 Sep 1992, 1200 m, *J.A. Villarreal 6927, M.A. Carranza & R. Vásquez* (ANSM); Madera del carmen, 7.2 mi NW of Pilares, 7 Sep 2005, 1700 m, *P.M. Peterson 18875, J. Valdés-Reyna* (US); Sierra La Encantada, 140 km al N de Múzquiz, entronque Boquillas del Carmén brecha y túnel, Flourita de México Unidad Minera, 6 km al SO pasando el túnel, 7 Sep 1990, 1500 m, *M.A. Carranza 709, J. Valdés-Reyna, P.A. Fryxell & R. Vásquez* (ANSM); Municipio de Nava, Sierra El Jardín, Canyon del Diablo, 9 mi from jct of road towards Boquillas, 2 Sep 2006, 1418 m, *P.M. Peterson 19880, S. Lara-Contreras* (US); Sierra El Jardín, slopes above Canyon del Diablo, 2 Sep 2006, 1418 m, *P.M. Peterson 19907, S. Lara-Contreras* (US); Sierra El Jardín, 8 mi SW of Rancho La Mula, 4 Sep 2006, 1394 m, *P.M. Peterson 19959, S. Lara-Contreras* (US); Municipio de Ocampo, O base of Picacho del Fuste, NE from Tanque Vaionetta, N facing montain-side, 23 Aug 1941, *I.M. Johnston 8425* (MEXU); Ocampo, 1 Aug 1972, 1260 m, *R. Vasquez, Noriega* (ANSM); Sierra El Pino, 33.5 km W of Rancho El Cimarron, 14 Sep 1991, 1500 m, *P.M. Peterson 10652, & C.R. Annable* (US); Sierra El Pino, 39.5 km W of Rancho El Cimarron, 14 Sep 1991, 1500 m, *P.M. Peterson 10678, & C.R. Annable* (US); Madera del Carmen, 9.7 mi NE of Los pilares, 21 Sep 2007, 1902 m, *P.M. Peterson 20935, J.M. Saarela, S. Lara-Contreras & J. Reyna* (US); Municipio de Parras, Sierra de Parras en el cañón de Gustrola, 1 Sep 1988, 2050 m, *A, Rodríguez 566, P. Antonio* (ANSM); Municipio de Ramos Arizpe, Sierra de la Paila (Lado Norte) Cañada Becerros, 13 Oct 1989, 1700 m, *J.A. Villarreal 5450, M.A. Carranza & L. Arce* (ANSM); Sierra de la Paila, Ejido el Cedral por el camino El Carmen, 4 Oct 1989, 1300 m, *J.A. Villarreal 5336, M.A. Carranza & A. Rodríguez* (ANSM); Municipio de Sabinas, 85.4 km NW of Muzquiz on Hwy 53 towards Boquilla del Carmen, vía La Rosita, 12 Sep 1991, 810 m, *P.M. Peterson 10569, C.R. Annable* (US); Municipio de Saltillo, Hacienda Buena Vista al SE de la Universidad Autónoma Agraria Antonio Narro, 11 Sep 1981, 1600 m, *G. Villaseñor s.n.* (MEXU); on carretera 54, 6 km S de Saltillo, area

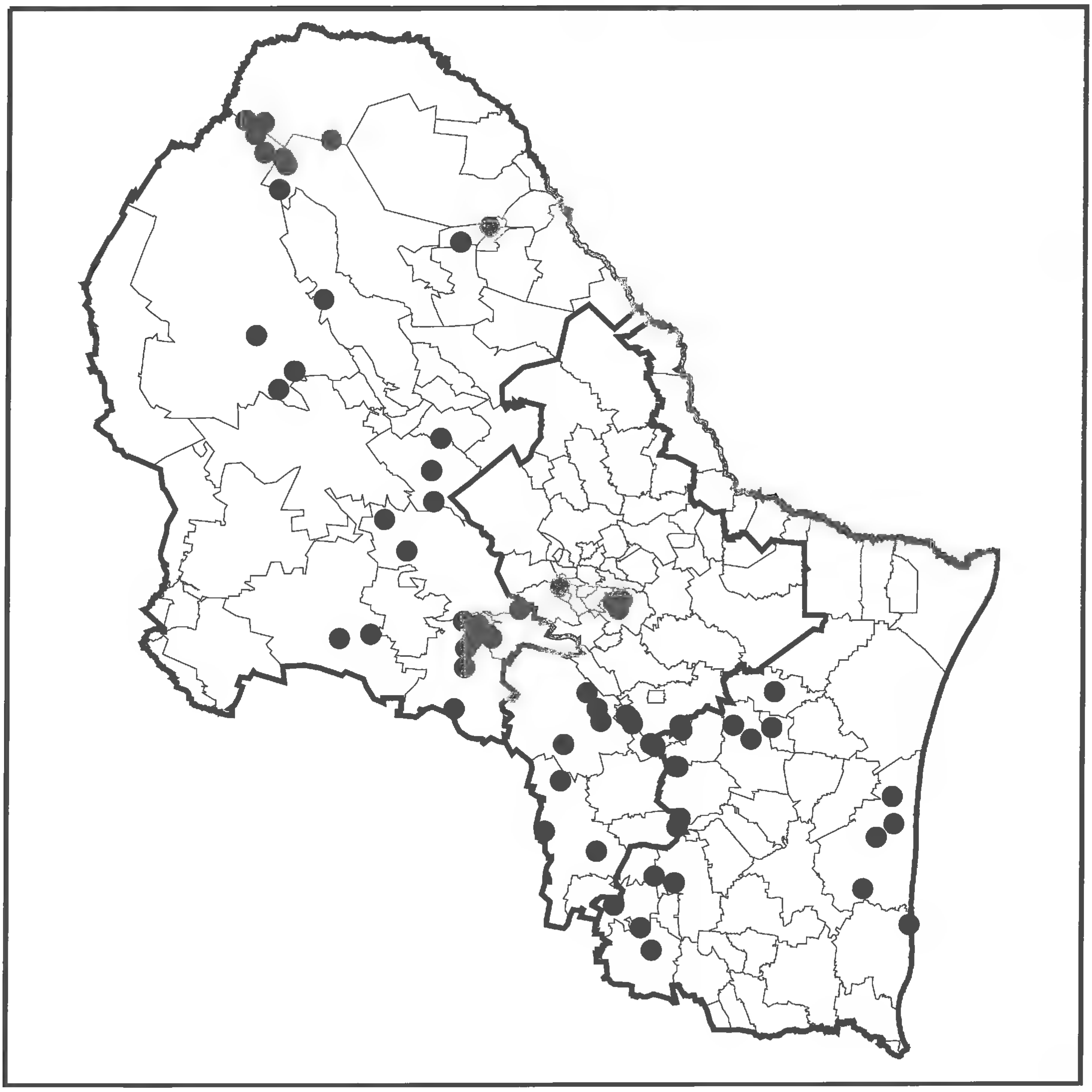


Fig. 17. Distribución de *Bouteloua hirsuta* var. *hirsuta* en el noreste de México.

de Reforestación de Zapalinamé, near Universidad Autónoma Agraria Antonio Narro, 18 Sep 1988, 1900 m, *M.E. Barkworth 5110, P.S. Hoge, J. Valdés-Reyna & M.A. Carranza* (ANSM); Rancho experimental Los Angeles, 48 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 26 Aug 1981, 1800 m, *S.L. Hatch 4535, C.W. Morden & J. Valdés-Reyna* (ANSM); 18 Oct 1989, 2140 m, *P.M. Peterson 8428, M.A. Carranza* (US); 2 Sep 1978, *J.S. Sierra s.n.* (ANSM, MEXU); 14 Sep 1992, *J.A. Villarreal 6714, M.A. Carranza & D.E. Lozano* (ANSM); Municipio de San Buenaventura, Sierra La Encantada, rancho Carrizalejo, entrada S al rancho Puerto del Aire, 8 Sep 1990, 1200 m, *M.A. Carranza, J. Valdés-Reyna, P.A. Fryxell, R. Vásquez & O. Meza* (ANSM). **Nuevo León:** Municipio de Cadereyta Jiménez, 4 km NE de Cadereyta Jiménez, 20 Abr 1973, 330 m, *J.S. Marroquín 2502* (ANSM); en los alrededores del poblado de Cadereyta, 22 Mar 1993, 320 m, *N. Bazaldua 35* (MEXU); Municipio de Doctor Arroyo, 21 km al N de Matehuala, San Luis Potosí, 19 Sep 1984, 1800 m, *P. Hiriart 315, V. Juárez & R. Molczadzki* (UAT); 70 mi N of Matehuala on Hwy 61 towards Linares and 1.5 mi N of La Rosita, 19 Oct 1995, 1940 m, *P.M. Peterson 13361, M.B. Knowles* (US); 9.4 mi W of San Antonio de Peña Nevada & 0.4 mi E of jct of Hwy 2 to Or., 22 Sep 2002, 1807 m, *P.M. Peterson 16795, J. Valdés-Reyna & M. Sosa* (US); Municipio de Galeana, 2 mi W of Dieciocho de Marzo up road towards Cerro Potosí, 18 Oct 1995, 2130 m, *P.M. Peterson 13324, M.B. Knowles* (US); 25 km E of San Roberto along highway 58, 27 Aug 1981, 1740 m, *S.L. Hatch 4575, C.W. Morden & J. Valdés-Reyna* (ANSM); km 636 carretera Galeana-San Roberto, *I. Cabral 1087* (IEB); Municipio de General Zaragoza, Camino a Tinajas, 5 Nov 1982, 1530 m, *A. Brito 107* (MEXU); Municipio de Iturbide, 1 km NE de Cadereyta, 14 Oct 1971, 320 m, *J. Valdés-Reyna 3* (ANSM); Bosque-escuela, Universidad Autónoma de Nuevo León, 12 km E de Iturbide, 18 Oct 1987, 1500 m, *I. Cabral 1093* (ANSM); Ejido Santa Rosa, 29 Aug 1989, 1550 m, *E.A. Estrada 1677* (ANSM); Municipio de Monterrey, Monterrey, *T. Tateoka 1090* (US). **Tamaulipas:** Municipio de Aldama, Playa Rancho Nuevo, 18 Aug 1985, 60 m, *R. Díaz 28* (ANSM, UAT); Santa Rosa, 29 Aug 1981, *J.L. Ramos s.n.* (MEXU); Municipio de Altamira, Rancho La Fortuna, 9 Oct 1980, 50 m, *R. Sandoval 661* (MEXU); Municipio de Burgos, Rancho La Granja, 18 Oct 1983, 200 m, *J.F. Iribe 206* (MEXU); Municipio de Bustamante, Cerro Tinaja. Vicinity of San José, 14 Jul 1930, 731 m, *H.H. Bartlett 10342* (MEXU); Municipio de Gómez, km 26, Rancho el Soldado, 28 Sep 1993, 150 m, *O.M. Galván 603* (MEXU); Municipio de Hidalgo, Ejido Nicolás Bravo, 29 Oct 1989, *J. Cantú 40* (IEB, MEXU); Municipio de Mainero, km 5 hacia El Ejido Camarones, 25 Jul 1986, 750 m, *M.H. Cervera 352* (MEXU); La Oveja (Venustiano Carranza), 19 Nov 1986, 800 m, *M.H. Cervera 398* (MEXU); Municipio de Matamoros, Dunas del Mezquite, 11 Jul 1981, *J. Cantú 311* (MEXU); Municipio de Miquihuana, El Angelito, Colonia La Peña, 24 Nov 1981, 660 m, *J.F. Iribe s.n.* (MEXU); Municipio de Palmillas, 12 km al NO Palmillas, Sep 1976, 1700 m, *F. González 10013, P. Zavaleta* (MEXU); Municipio de San Carlos, Piedra Imán, 2 km ESE de San José, Sierra de San Carlos, 22 Nov 1984, 790 m, *O.L. Briones 1213* (ANSM); Municipio de San Nicolás, Rancho La Trinidad, Oct 1983, 650 m, *J.F. Iribe 201* (MEXU); Municipio Soto la Marina, Ejido 5 de Mayo, 18 Sep 1981, 140 m, *J.G. Galván 7* (MEXU); Ejido Benito *Juárez*, 3 Oct 1986, *J.F. Iribe 323* (MEXU); Ejido Los Arroyos, 22 Oct 1983, *A. Brito 153* (MEXU); Rancho San Isidro, 22 Oct 1986, 30 m, *J.F. Iribe 340* (MEXU); Municipio de Tula, 22 km NO de Tula, límite entre los municipios de Tula y Bustamante, 9 Feb 1984, 1400 m, *L. Hernández 966* (UAT); 5–6 km al S del Capulín, 10 Aug 1972, 1800 m, *F. González 4454, R.M. López & R. Dirzo* (MEXU); Municipio de Villagrán, 3 mi S of Nuevo Leon line on the Villagrán-Linares highway, 12 Nov 1959, 400 m, *J. Graham 4665, M.C. Johnston* (MEXU, UAT); 1 mi al E de Morales y 5 mi al W de Loreto, *M.C. Johnston 5545-B* (US).

12. Bouteloua johnstonii Swallen, Proc. Biol. Soc. Wash. 56:79. 1943. (**Fig. 18**). Tipo: MÉXICO. Coahuila: S de Canada Oscuro, near Tanque La Luz, 27 Sep 1942, *I.M. Johnston 8491* (holotipo: NA-154624; isotipos: GH, US-1817790!).

Plantas perennes, amacolladas, macollos de 10 a 20 cm de diámetro. Culmos de 10 a 40 cm de alto, densamente ramificados, de base dura, rizomatosa. Vainas glabras, con margenes hialinos; lígula un diminuto anillo de pelos de 0.5 mm de largo; láminas foliares de 5 a 12 cm de largo y 1 a 2 mm de ancho, rígidas, estrechas, curveadas en la madurez, involutas en toda su largo, con el ápice rígido como espina, abundante lanoso-pubescente en la superficie adaxial, y en ambas superficies hacia la base, los pelos largos hasta de 4 mm de largo, cambiando a glabras con la madurez. Inflorescencia largamente exserta; ramificaciones primarias espigadas 6 a 12, de 8 a 15 mm de largo y 5 a 10 mm de ancho, erectas o ascendentes, caedizas en la madurez, portando 7 a 11 espiguillas; raquis aplanado, ligeramente escabroso, algo sinuoso. Espiguillas de 5 a 7 mm de largo, permanecen insertas a las ramificaciones; glumas desiguales, color púrpura, delgadas, agudas a acuminadas o cortamente aristadas, primera gluma de 3.5 a 4 mm de largo, angosta, largamente acuminada, ligeramente escabrosa o corto pubescente en la mitad inferior, segunda gluma de 5 a 7 mm de largo, esparcidamente hirsuta, con un mucrón corto; lema de la flor perfecta de 5 a 6 mm de largo, glabra con algunos pelos adpresos hacia la base, redondeada en el dorso, los nervios se prolongan en aristas fuertes, las aristas laterales cortas, escabrosas, la central más larga, de 2 a 3 mm de largo, emergiéndo entre dos lóbulos membranáceos; pálea de 4 a 4.2 mm de largo, glabra. Anteras de 2 a 2.2 mm de largo, color amarillo claro, con los filamentos pubescentes. Flósculo rudimentario 1 (2), el primero de 6 a 7 mm de largo, formado por una columna glabra con 3 aristas aplanadas, fuertes, escabrosas, alternas con 4 aristas pequeñas, de 2.5 a 3 mm de largo, muy delgadas, escabrosas; segundo flósculo cuando presente muy reducido. Cariopsis de 2 a 2.2 mm de largo, color amarillo, oblongo-elipsoide. Florece de agosto a octubre.

Distribución.—Especie endémica mexicana conocida de Coahuila y Zacatecas.

Hábitat.—Planta escasa, presente en suelos yesosos; 1200 a 1600 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Francisco I. Madero, S part of Sierra de los Organos; approach 9.5 km E of Puerto del Gallo, then by foot S into large canyon, 8 Aug 1973, 1200 m, *M.C. Johnston 12114, F. Chiang, T.L. Wendt & J. Henrickson* (ANSM); Municipio de General Cepeda, Sierra de la Paila al O en el Ejido Nueva Imagen, 5 Oct 1985, 1400 m, *A. Rodríguez 1483* (ANSM, ENCB); Rancho Parritas, W de Coahuila, base de la montaña, margen E del Valle de Acatita, *R.M. Stewart 2763* (US); Municipio de Ramos Arizpe, Sierra de la Paila, Valle de Parreños, 31 Oct 1987, 1600 m, *J.A. Villarreal 4173, J.L. Elizondo & J.J. López* (ANSM, CIIDIR).

13. Bouteloua karwinskii (E. Fourn.) Griffiths, Contr. U.S. Natl. Herb. 14(3):394, f. 47, t. 76. 1912. (**Fig. 19**). *Chondrosium karwinskii* E. Fourn., Mexic. Pl. 2:137. 1886. Tipo: MÉXICO: Cañón de las Minas et Victoria, *Karwinsky 1479* (holotipo: P; isotipos: LE, US-A865682 fragm.!).

Plantas perennes. Culmos de 20 a 55 cm de alto, delgados, erectos, ramificados desde una base dura y fuertemente rizomatosa; entrenudos glabros. Vainas más cortas que los entrenudos, glabras, ciliadas solo

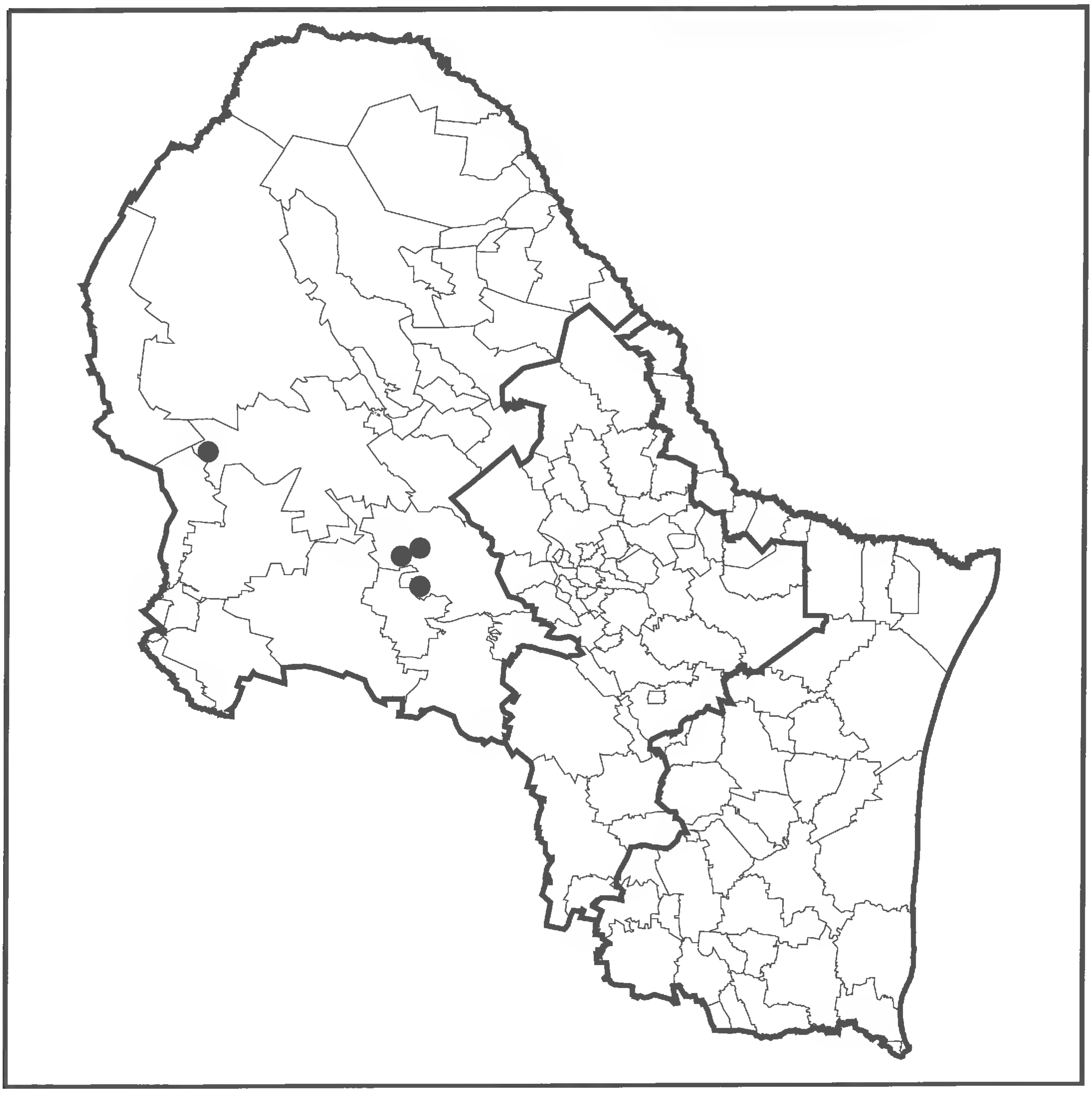


Fig. 18. Distribución de *Bouteloua johnstonii* en el noreste de México.

en el margen, con algunos pelos largos en la garganta; lígula un anillo ciliado de 0.3 mm de largo; láminas foliares de 3 a 9 cm de largo y 1 a 2 mm de ancho, aplanadas. escabrosas, esparcidamente pilosas en la superficie adaxial, curvas. Inflorescencia con 3 a 6 espigas persistentes; ramificaciones primarias espigadas de 1 a 1.8 cm de largo, espaciadas y casi erectas, portando 10 a 15 espiguillas. Espiguillas 3 a 3.5(–4) mm de largo, articulación por arriba de las glumas; glumas desiguales, glabras a esparcidamente pubescentes sobre la quilla, primera gluma de 1.5 a 2 mm de largo, estrecha acuminda, segunda gluma de 2 a 2.5 mm de largo, más ancha que la primera, aguda; lema de la flor perfecta de 2.5 a 3.2 mm de largo, esparcidamente aplicado-pubescente sobre las nervaduras y la base, las nervaduras laterales se transforman en 2 aristas fuertes, de 1 a 1.5 mm de largo, no sobresalen del ápice agudo de la lema. Flósculos rudimentarios (1) 2, lema del primer flósculo de 1 mm de largo, ancha, con las tres nervaduras prolongadas en aristas de 1.5 mm de largo; segundo flósculo de 1 mm de largo, incluyendo las 3 aristas escabrosas, raquilla glabra en la

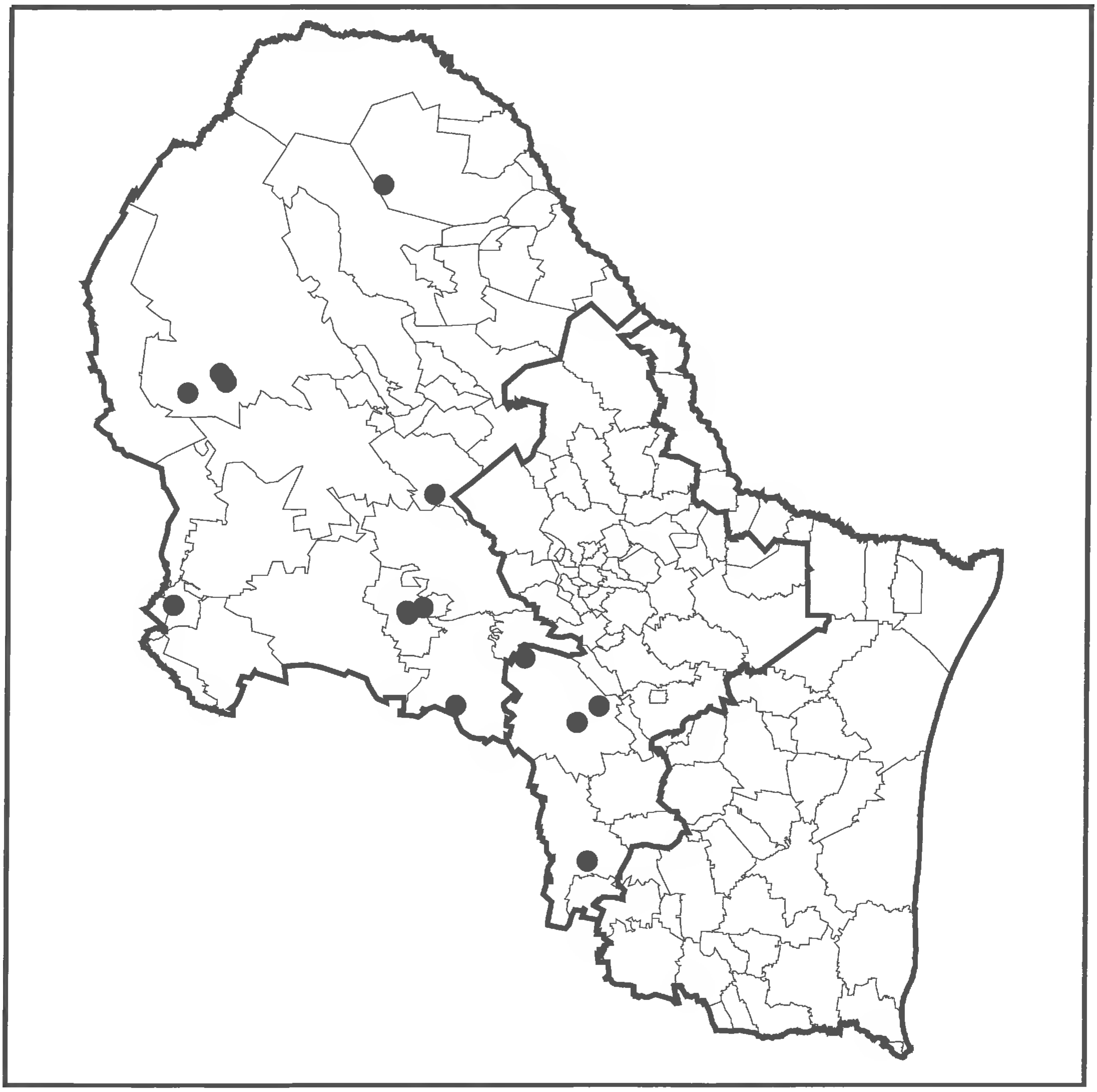


Fig. 19. Distribución de *Bouteloua karwinskii* en el noreste de México.

base del flósculo rudimentario. Cariopsis de 0.7 a 1 mm de largo, color amarillo claro a café en la madurez, estrechamente elíptica. $2n = 20$. Florece de junio a noviembre.

Distribución.—México en: Coahuila, Nuevo León, San Luis Potosí y Zacatecas.

Hábitat.—Suelos salinos y yesosos, en pastizales y matorrales de *Larrea* al NE de México; 1000 a 1650 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Castaños, Rancho de Santa Teresa, al S de Castaños (MEXU); Municipio de General Cepeda, Ejido La Rosa, carretera 40 Saltillo-Torreón, aprox. 20 km NE de General Cepeda, 5 Jul 1986, 1230 m, *S. Vásquez 84, A. García* (ANSM); km 45 carr. 40 Saltillo-Torreón, en la desviación a Gral. Cepeda, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1478* (CIIDIR, HUAA); Municipio de Ocampo, 1–2 mi O of Matrimonio Viejo about mogote at base of slightly saline and gypseons slope, 23 Sep 1941, *I.M. Johnston 9370* (MEXU, US); Laguna de La Leche, 22 Jun 1978, 1000 m, *J. Valdés-Reyna 1334, H. Garza & L.E. Rodríguez* (ANSM); S of Laguna de La Leche, 30 Aug 1941, *I.M. Johnston 8618* (MEXU); Laguna de la Vaca, Ocampo, *J. Valdés-Reyna s.n.* (ANSM); Municipio de Saltillo, 26 mi NNE de Concepción del Oro, *J.R. Reeder 4000* (US). Nuevo León. Municipio de Dr. Arroyo, Ejido Lagunita y Ranchos Nuevos, *M.E. Pérez 108* (CIIDIR); Municipio de Galeana, Just E of San Roberto jct. along hwy. 57, *J.R. Reeder & C.G. Reeder*

7060 (ENCB, IEB, US); Gypsom flats, 3 mi S of Galeana, *D.S. Correll 19851* (MEXU); *G.A. González 674* (SLPM); *G.A. Gómez 715* (MEXU, SLPM); *J. Rzedowski 8279* (ENCB, SLPM); *J.R. Reeder & C.G. Reeder 2926* (MEXU); *J.M. Peña 674* (UAG); *J. Rzedowski 8281, 11460* (ENCB); Navidad, carretera 57, km 85 al N de Saltillo, 23 Sep 1978, 1650 m, *F. Cárdenas & M.A. Bernal* (MEXU).

14. Bouteloua parryi (E. Fourn.) Griffiths, Contr. U.S. Natl. Herb.14(3):381, f. 37, pl. 73. 1912. *Chondrosium parryi* E. Fourn., Mexic. Pl. 2:150. 1886. Tipo: MÉXICO. San Luis Potosí: near San Luis Potosí, 1878, *C.C. Parry & E. Palmer 943 ½* (holotipo: BR?; isotipos: US-81783!, US-883835!).

Plantas anuales o perennes de vida corta, cespitosas. Culmos de 10 a 60 cm de alto, erectos o a veces geniculados, generalmente con estolones. Vainas más cortas que los entrenudos, los márgenes hialinos, con pubescencia larga, esparcida, de base papilosa, más abundante cerca del collar; lígula ciliada de 0.5 a 0.8 mm de largo; láminas foliares de 1 a 15 cm de largo y 0.5 a 3(–4) mm de ancho, las superiores más cortas, glabras a piloso-papilosas en ambas superficies, los pelos llegan a medir hasta 3.5 mm de largo, principalmente en los márgenes hacia la base. Inflorescencia de 6 a 30 cm de largo, con 3 a 8 ramificaciones primarias espigadas persistentes; ramificaciones de 1 a 3 cm de largo, portando 25 a 65 espiguillas sobre un raquis plano, piloso-papiloso; raquis sin extenderse más allá del punto de inserción de la espiguilla terminal. Espiguillas de 3 a 4(–6) mm de largo, incluyendo las aristas, articulación por arriba de las glumas; glumas desiguales, primera gluma de 1 a 1.8 mm de largo, hialina, glabra, aristada, segunda gluma de 3 a 3.5(–5) mm de largo, corto aristada, la arista hasta de 1 mm de largo, emergiendo de un ápice bífido, piloso-papilosa sobre la quilla; lema de la flor perfecta de 3.5 a 4 mm de largo, pilosa en la base, 3-aristada, aristas de 1 a 3 mm de largo, alternando con 3 lóbulos; pálea del mismo tamaño que la lema, dentada, 2-aristada, aristas pequeñas, ligeramente pubescente en los márgenes. Anteras de 2 a 3 mm de largo, color crema a amarillo claro. Flósculos rudimentarios 2, lema del primer flósculo de 2 a 3 mm de largo, barbada en la base, 3-aristada, aristas de 2 a 3 mm de largo, con lóbulos obtusos; lema del segundo flósculo sin aristas, reducido a una escama. Cariopsis 1.8 a 2.5 mm de largo, anguloso-triangular.

Comentarios.—Especie con dos variedades reconocidas, sólo la una variedad en Coahuila.

Bouteloua parryi var. **parryi** (E. Fourn.) Griffiths. (**Fig. 20**).

Bouteloua polystachya var *vestita* S. Watson, Proc. Amer. Acad. Arts 18:177. 1883. *Bouteloua vestita* (S. Watson) Scribn. ex L.H. Dewey, Contr. U.S. Natl. Herb. 2(3):531. 1894. Tipo: MÉXICO: Sierra Madre S of Saltillo, *E. Palmer 1357* (holotipo: GH).

Plantas anuales. Culmos de 20 a 60 cm de alto, erectos o abiertos basalmente, no estoloníferos. Láminas foliares de 3 a 15 cm de largo y 2 a 3(–4) mm de ancho, piloso-papilosas. Inflorescencia de 15 a 30 cm de largo, con 4 a 8 ramificaciones primarias espigadas, de 2 a 3 cm de largo, con 40 a 65 espiguillas. Espiguillas de 3.5 a 4(–6) mm de largo. Florece de agosto a diciembre.

Distribución.—Desde el Sw de Estados Unidos a México en: Coahuila, Colima, Chihuahua, Durango, Jalisco, San Luis Potosí, Sinaloa, Sonora y Zacatecas.

Hábitat.—Se le encuentra en laderas arenosas, mesetas y colinas rocosas, y a orilla de carretera.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Saltillo, Sierra S of Saltillo, *E. Palmer 1357* (US).

15. Bouteloua pedicellata Swallen, N. Amer. Fl. 17:627. 1939. (**Fig. 21**). Tipo: MÉXICO. Puebla: Chalchicomula, 9000 ft, 19 Aug 1910, *A.S. Hitchcock 6302* (holotipo: US: 883950!; isotipo: US!).

Plantas bajas perennes. Culmos de 15 a 25 cm de alto, desarrollando estolones largos y espiralado-aéreos, hasta de 45 cm de largo. Hojas principalmente basales; vainas más cortas que los entrenudos, escabrosas, con escasa pubescencia larga, dispersa; lígula de 0.5 a 0.8 mm de largo, un anillo ciliado denso; láminas foliares de 2 a 5 cm de largo y 0.4 a 0.7 mm de ancho, involutas, algunas aplanadas cerca a la inflorescencia, color verde-grisáceas, escabosas en ambas superficies, con algunos pelos largos dispersos en la superficie adaxial, principalmente hacia la base cerca de la lígula. Inflorecencia 8 a 12(–15) cm de largo, largamente exserta, con 10 a 20 ramificaciones primarias espigadas caedizas en la madurez, divergentes o reflejas; ramificaciones de 8 a 9(–10) mm de largo, la mayoría portando una sola espiguilla péndula, conspicuamente pedicelada, pedicelo de 2 a 3 mm de largo; raquis aplanado, con márgenes ciliados. Espiguilla de 8 a 9 mm de largo, permanece inserta a la espiga; glumas anchas, firmes, sin aristas, escabroso-pubescentes en las quillas, con

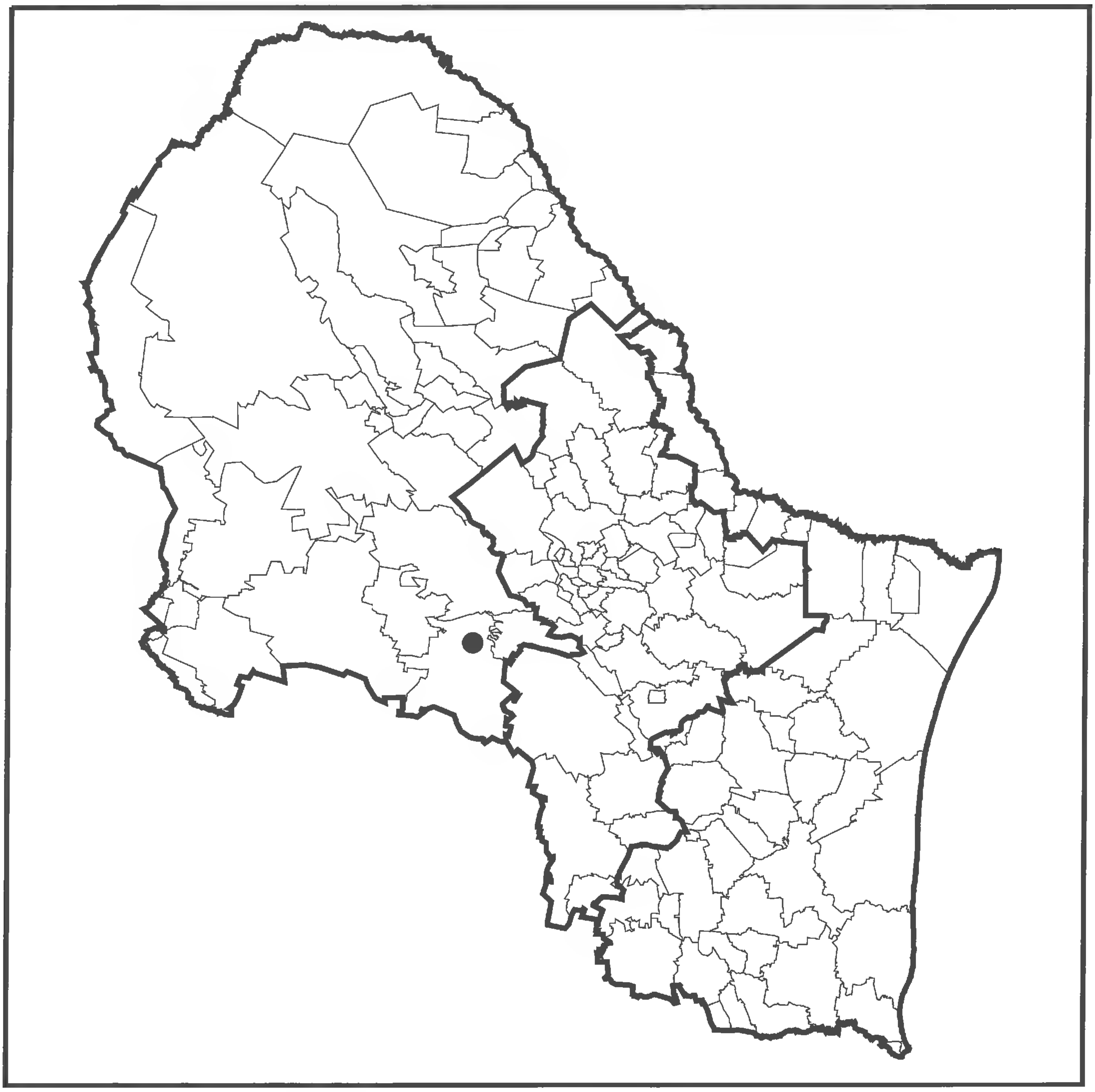


Fig. 20. Distribución de *Bouteloua parryi* var. *parryi* en el noreste de México.

tintes purpúreos, primera gluma de 4 a 5 mm de largo, con ápices obtusos, finamente ciliados hasta los márgenes, segunda gluma de 8 a 9 mm de largo, aguda a acuminada, con la quilla escabroso-pubescente, márgenes angostamente hialinos; lema de 7 a 8 mm de largo, glabra, con los márgenes hialinos, sin arista; pálea de 6 a 7 mm longitud, angosta, ligeramente escabrosa. Anteras de 2.5 a 3 mm de largo, color amarillo claro. Flósculo rudimentario 1, reducido a tres aristas escabrosas, diminutas, las laterales de 2 mm de largo y la central más ancha y larga, de (3.5–)4 a 4.5 mm de largo, no exserta de la espiguilla. Cariopsis de 2.4 a 3 mm de largo, color pajizo, oblongo-elipsoide. Florece de julio a septiembre.

Distribución.—México en: Guanajuato, Puebla, Tlaxcala y Veracruz; ahora encontrada en Nuevo León.

Hábitat.—Sobre laderas rocosas, principalmente en pastizales; 1950–2500 m de altitud.

Ejemplares examinados. **MÉXICO: Nuevo León:** Municipio de Dr. Arroyo, 8.8 km W of Dr. Arroyo and 37 km E of Matehuala on Hwy 3, 13 Oct 1991, 1950 m, *P.M. Peterson 11140, C.R. Annable* (US).

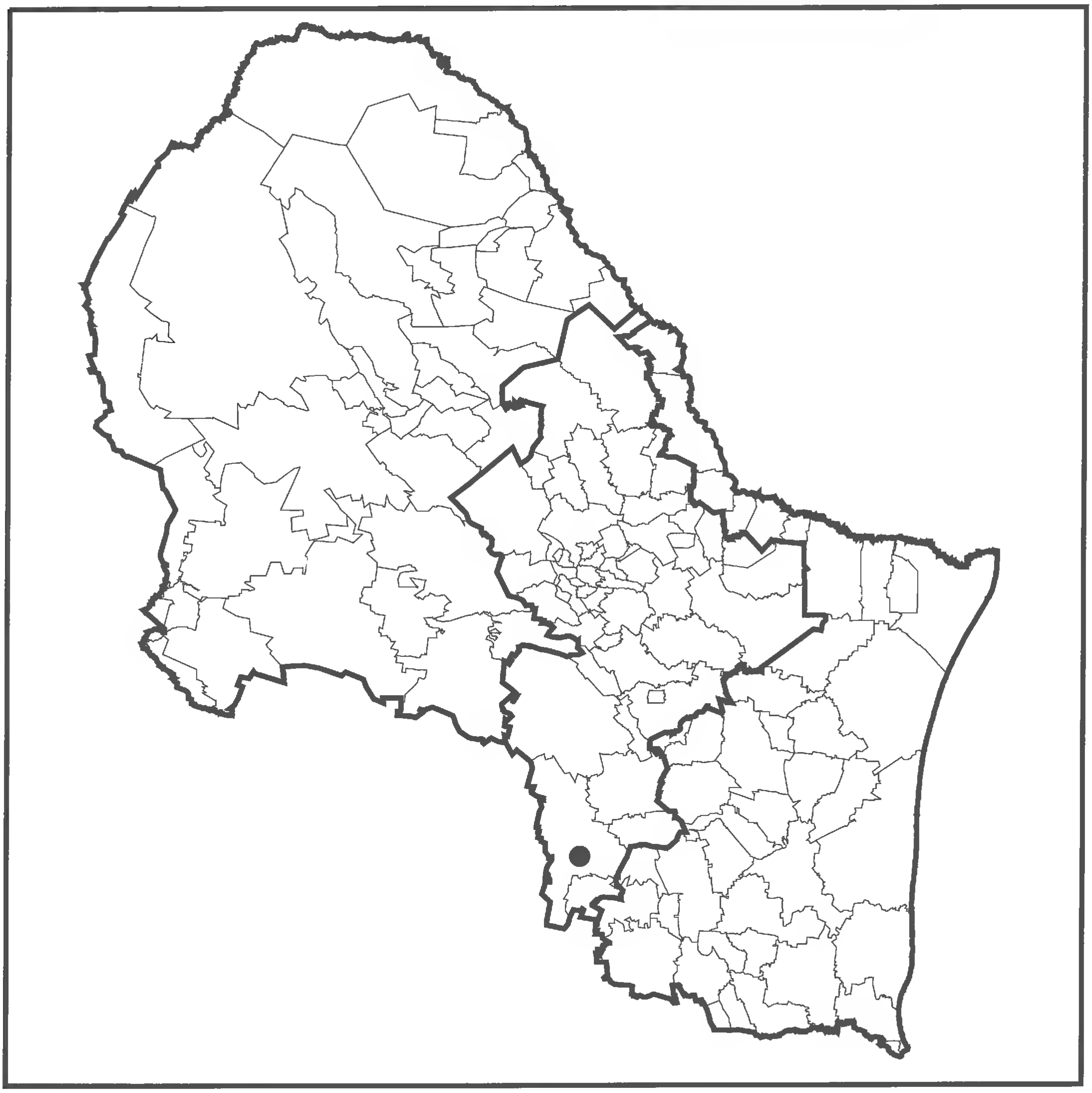


Fig. 21. Distribución de *Bouteloua pedicellata* en el noreste de México.

16. Bouteloua radicosa (E. Fourn.) Griffiths, Contr. U.S. Natl. Herb. 14:411. 1912. (**Fig. 22**). *Atheropogon radicosus* E. Fourn., Mexic. Pl. 2:140. 1886. *Bouteloua bromoides* var. *radicosa* (E. Fourn.) Vasey ex L.H. Dewey, Contr. U.S. Natl. Herb. 2(3):533. 1894. Tipo: MÉXICO: near México City, 8 Jun 1865–18 Jun 1866, *M. Bourgeau 450* (lectotipo: P, designado por Griffiths, Contr. U.S. Natl. Herb. 14:411, 1912; isolectotipos: BR, F, GH, LE, MPU, US-81791!, US-87200 fragm. ex P!, US-883896 fragm.!).

Dinebra bromoides Kunth, Nov. Gen. Sp.(quarto ed.) 1:172, t. 51. 1816. *Atheropogon bromoides* (Kunth) Roem. & Schult., Syst. Veg. 2:415. 1817. *Eutriana bromoides* (Kunth) Trin., Fund. Agrost. 161, 162. 1820. *Eutriana bromoides* (Kunth) Kunth, Revis. Gramin. 1:95. 1829. Tipo: MÉXICO. Guanajuato: "Crescit in temperatis scopulosis aridis inter Guanaxuato et Cubilete Mexicanorum," Sep, *F. Humboldt & A. Bonpland s.n.* (holotipo: P; isotipo: US-865871 fragm. ex P y foto!).

Plantas perennes. Culmos de 40 a 80 cm de alto, erectos, base conspicuamente rizomatosa, rizomas muy engrosados y escamosos; entrenudos de 1 a 2 mm de largo en la base, típicamente cubiertos por vainas firmes. Hojas generalmente basales; vainas glabras, más cortas que los entrenudos; lígula de 0.5 a 1 mm de largo, en forma de un anillo de pelos; láminas foliares de 6 a 10(–30) cm de largo y 1.5 a 2.5 mm de ancho, aplanadas,

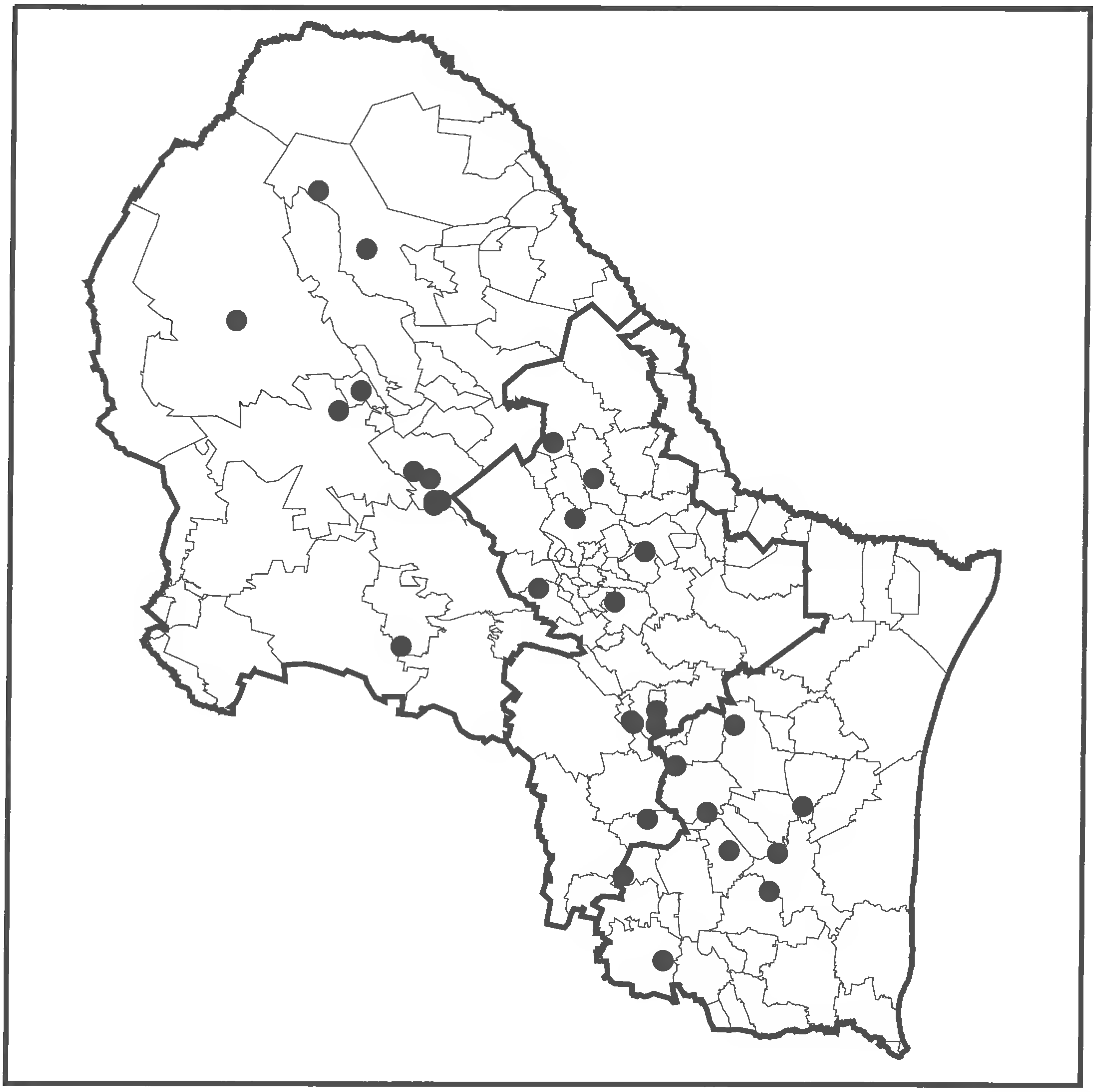


Fig. 22. Distribución de *Bouteloua radicosa* en el noreste de México.

ciliadas en los márgenes, con pelos de base papilosa, de 2 a 4 mm de largo, a menudo esparcidamente pilosas en ambas superficies. Inflorescencia de 6 a 15 cm de largo y 5 a 8 mm de ancho, con 5 a 12 ramificaciones primarias espigadas, erectas o ascendentes, oblongas en el contorno general, desprendiendose íntegras en la madurez; ramificaciones de 1.5 a 3 cm de largo, portando 6 a 12 espiguillas, por lo general barbadas en la base, insertas sobre las ¾ partes de un raquis glabro, así el raquis se prolonga 4 a 8 mm delante de la espiguilla terminal. Espiguillas 9 a 13 mm de largo, incluyendo las aristas, permanecen insertas a la espiga; glumas desiguales, 1-nervadas, con tintes purpúreos, primera gluma de 5 a 6 mm de largo, ancha, aguda a acuminada, glabra o con escasa pubescencia en el raquis, segunda gluma de 6 a 7 mm de largo, glabra a escabrosa en la quilla, acuminada; lema de la flor perfecta de 7 a 9 mm de largo, sin aristas o con 3 aristas cortas, la central hasta de 2 mm de largo, glabra a escabrosa hacia el ápice; pálea ligeramente mas pequeña que la lema, sin nervios notorios, glabra o con escasa pubescencia a lo largo de la parte central. Anteras de 3 a 4 mm de largo, rojizas. Flósculo rudimentario 1, lema del flósculo de 8 a 12 mm de largo, incluyendo las 3 aristas fuertes, aplanadas, con tonos purpúreos; pálea angosta, casi tan larga como la lema. Cariopsis de 1.3 a 1.6 mm de largo, color amarillo, ovoide a estrechamente elíptica. $2n = 20{,}60$. Florece de julio a diciembre.

Distribución.—Sw de Estados Unidos a casi todo México.

Hábitat.—En laderas secas rocosas, pastizales y matorrales xerófilos; 210 a 2000 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Castaños, 1 km N de cuesta La Muralla y restaurant la Muralla, 24 Sep 1977, 1150 m, *J. Valdés-Reyna 1308, L.E. Rodríguez* (ANSM); S end of Puerto San Lázaro (Cuesta La Muralla), 0.5 mi N of San Lázaro along route 57, 28 Jul 1977, 1250 m, *J. Valdés-Reyna 1102, T.L. Wendt* (ANSM); S end of Puerto San Lázaro (Cuesta La Muralla), 0.5 mi N of San Lázaro along route 57, 28 Jul 1977, 1250 m, *T.L. Wendt & J. Valdés-Reyna* (CHAPA, MEXU); Sierra de la Gavia, Cañón de la Gavia, aproximadamente 6 km S de la casa camino al cañón, 14 Aug 1986, 1480 m, *J. Valdés-Reyna 1709, M.A. Carranza & D. Frame* (ANSM); Sierra de la Gavia, Cañón la Gavia, 6 km S de la casa camino al cañón, 20 Sep 1989, 1480 m, *P.S. Hoge 306, M.E. Barkworth & M.A. Carranza* (ANSM); Municipio de Cuatrociénegas, Entrada al Casco del Rancho Potrero de Menchaca, 30 Aug 1980, 1180 m, *R. Vásquez 19, L.E. Rodríguez* (ANSM); Ladera baja de la Sierra de San Marcos, frente al poblado de Cuatrociénegas, 24 Jun 1989, 800 m, *A. Rodríguez 1221, M. Moreno & J.J. López* (ANSM); Sierra de San Marcos, cañón Grande, Ejido Estanque de Norias, aprox. 43 km O de la carretera 57 rumbo a Ejido Reforma, 1 Sep 1993, 1550 m, *M.A. Carranza 1708, J.A. Encina, J. Fierro & R. Rodríguez* (ANSM); Municipio de General Cepeda, 20 km sobre la carretera de General Cepeda-Parras, 12 Sep 1986, 1250 m, *J. Espinosa s.n.* (ANSM); Municipio de Múzquiz, Rancho La Peña, Sierra de Santa Rosa, 5 Dic 1981, 2000 m, *R. Salgado s.n.* (ANSM); Sierra Santa Rosa, 11 Ju 1976, 1800 m, *R. Vásquez s.n.* (ANSM). **Nuevo León:** Municipio de Cadereyta Jiménez, Carretera a Reynosa, 2 kmO de la Refinería Cadereyta, 26 Sep 1979, 320 m, *J.A. Villarreal, J. Valdés-Reyna* (ANSM); Municipio de Cerralvo, 5.2 mi S of Zaragoza on road towrds Ejido La Encantada, 21 Sep 2002, 1500 m, *P.M. Peterson 16738, J. Valdés-Reyna & M. Sosa* (US); Municipio de García, In desert scrub 17 mi E of Monterrey, 1 Jul 1947, *F.A. Barkley 7178, G.L. Webster & C.M. Rowell Jr.* (MEXU); Municipio de General Zaragoza, 4 km S of Zaragoza at jct of road to Cerro Viejo-Tepehuanes, 20 Sep 2001, 1630 m, *P.M. Peterson 15843, J. Valdés-Reyna* (US); Municipio de Iturbide, Cañada Marrubial, Santa Rosa, 7 Jul 1985, 1320 m, *B.A. Treviño 500* (ANSM); Ejido Santa Rosa, 29 Aug 1989, 1550 m, *E.A. Estrada 1669* (ANSM); Municipio de Lampazos de Naranjo, Exposición SE del Cerro Colorado, 17 Mar 1981, 500 m, *O.L. Briones 497* (ANSM); Municipio de Linares, Ejido Los Alamos, cañón de las Lajas, 8 Sep 1982, 700 m, *T.S.P.* s.n. (ANSM); 8 mi de Linares sobre la carr. a Galeana, *J. Crutchfield & M.C. Johnston 5835c* (US); Municipio de Sabinas Hidalgo, Sabinas Hidalgo, 29 Jun 1933, *C.H. Mueller 419, M.T. Mueller* (MEXU); Municipio de Salinas Victoria, La Soledad Salinas Victoria, May 1981, 500 m, *J.A. Ochoa 1130* (MEXU). **Tamaulipas:** Municipio Abasolo, 13 mi E de Abasolo, desviación a la carr. San T. Jimenez, *J. Crutchfield & M.C. Johnston 6140*^{a} (US); Municipio de Hidalgo, Ejido Nicolás Bravo, 30 Oct 1981, *J.A. Barrientos 103* (MEXU); La Aurora, 17 Aug 1983, 280 m, *J.F. Iribe 195* (MEXU); Municipio de Llera, Estación San Francisco, Sep 1985, *C.R. López 126* (MEXU); La Gloria, 14 Nov 1993, 210 m, *J.E. López 152* (MEXU); Municipio de Miquihuana, 18 km al SO de Miquihuana, 15 Aug 1972, 1700 m, *F. González 4754, M. López & R. Dirzo* (MEXU); Municipio de San Carlos, Piedra Imán, 2 kmESE de San José, Sierra de San Carlos, 22 Nov 1984, 790 m, *O.L. Briones 1215* (ANSM); Municipio de Soto La Marina, 35 km de Victoria, sobre la carr. a Casas y Soto la Marina, *F. Martínez 2305* (US); Municipio de Tula, Camino a San José de las Flores, 23 Oct 1986, 1280 m, *J.E. López 10* (MEXU); Municipio de Victoria, Colonia La Estrella, Ciudad Victoria, 20 Sep 1985, *J.G. Galván 85* (MEXU).

17. Bouteloua ramosa Scribn. ex Vasey, U.S.D.A. Div. Bot. Bull. 12(1): t. 44. 1890. (**Fig. 23**). *Bouteloua oligostachya* var. *ramosa* (Scribn. ex Vasey) Scribn. ex Beal, Grass. N. Amer. 2:418. 1896. Tipo: U.S.A. Texas. Presidio Co.: Chenate Mts., 1888, *G.C. Nealley 797* (lectotipo: US-883244!, designado por J. Reeder, Taxon 35:153. 1986).

Plantas perennes, con bases duras, nudosas y subrizomatosas. Culmos de 25 a 60 cm de alto, delgados, geniculados, correosos, conspicuamente ramificados en la mitad inferior, barbados en las axilas de las ramas; nudos 4 a 5, entrenudos glabros. Vainas más cortas que los entrenudos; lígula de 0.1 a 0.2 mm de largo, un collar de pelos diminutos; láminas foliares de 2 a 5(–7) cm de largo y 1 a 2 mm de ancho, aplanadas con el ápice involuto, membranáceas, nunca dísticas, acuminadas, pubescentes en la superficie adaxial y glabras en la superficie abaxial. Inflorescencia de 5 a 8 cm de largo, con (1) 2 (4) ramificaciones primarias espigadas persistentes; ramificaciones densas, de 1 a 2.5(–3.5) cm de largo y 4 a 5 mm de ancho, pectinadas, portando 25 a 45(–60) espiguillas; raquis pubescente, casi glabro con el tiempo, terminando en una espiguilla a menudo reducida y en forma de aguja. Espiguillas 4 a 5 mm de largo, articulación por arriba de las glumas; raquilla con mechones de pelos de 1 mm de largo en la base de la flor perfecta y de 2 mm en la primera flor reducida; glumas desiguales, agudo-acuminadas, glabras o esparcidamente pilosas en la base, primera gluma de 2 a 2.5 mm de largo, con una arista de 0.5 mm de largo, segunda gluma de 3 a 3.2 mm de largo, con un mucrón de 0.8 a 1 mm de largo, escabrosa; lema de 4 a 5 mm de largo, densamente pubescente, excepto en el ápice, con 3 aristas gruesas, de 1 a 1.2 mm de largo las laterales y de 1.5 a 2 mm de largo la central, escabrosas, de color púrpura; pálea de 2.5 a 4(–5) mm de largo, glabra. Flósculos rudimentarios 1 o 2, primer flósculo con tres aristas fuertes, de 3 a 5 mm de largo, incluyendo las aristas, híspida; segundo flósculo cuando presente

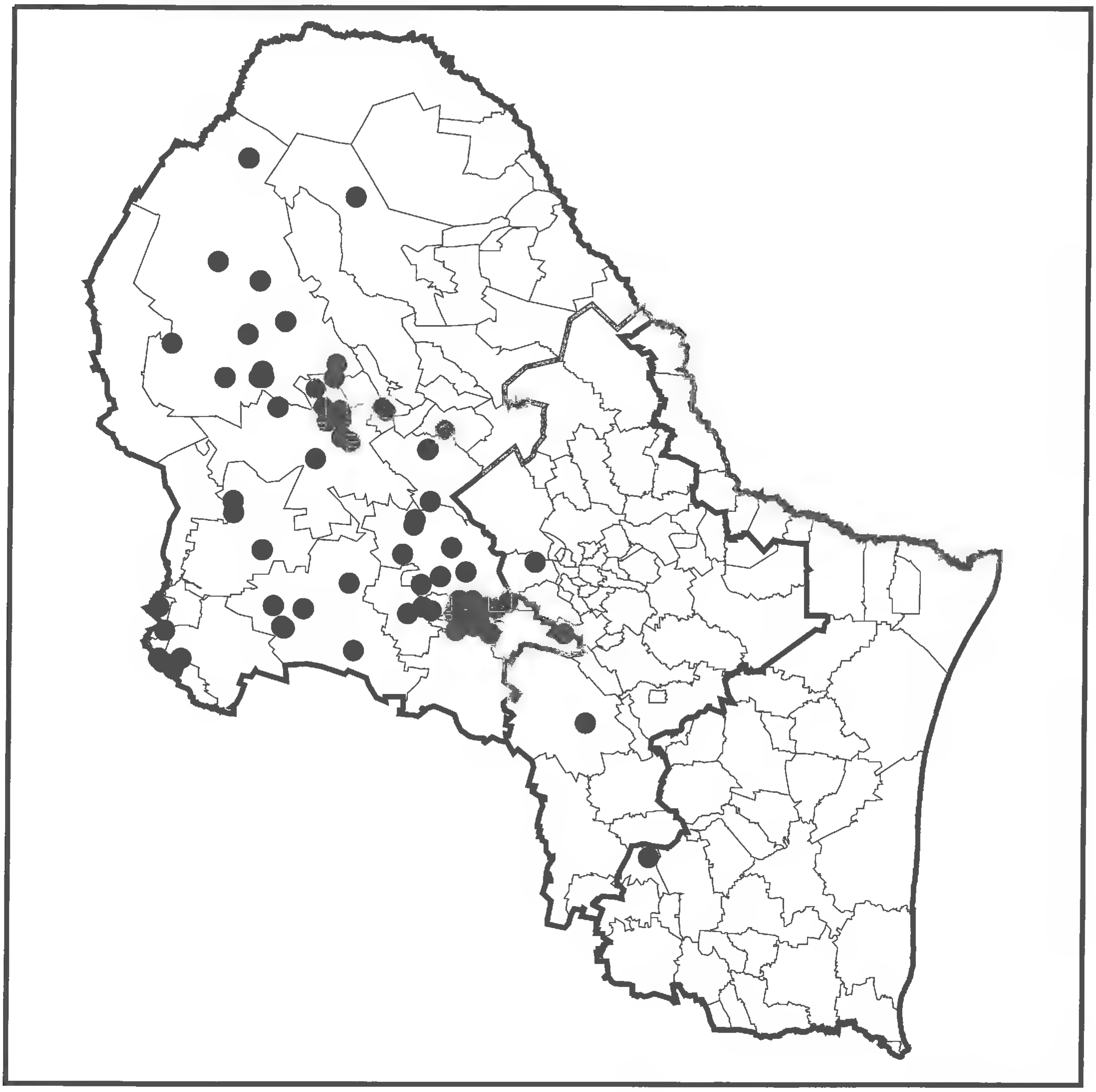


Fig. 23. Distribución de *Bouteloua ramosa* en el noreste de México.

en forma de escama diminuta. Anteras de 1 a 1.5 mm de largo. Cariopsis obovada, de 2 a 2.5 mm de largo, color amarillo claro, lanceolado-elíptica. $2n = 40$. Florece de julio a diciembre.

Comentarios.—*Bouteloua ramosa* ha sido confundida y considerada sinónimo de *B. breviseta* por diferentes autores, entre ellos Gould (1979); sin embargo, revisando los tipos de ambas especies se encontraron grandes diferencias, la principal es de tipo vegetativo. Mientras que *B. ramosa* presenta los culmos ramificados, delgados y correosos, hasta de 70 cm de alto; *B. breviseta* posee culmos no ramificados, no son delgados y correosos, por lo general son cortos, de 20 a 25(–30) cm de alto, rígidos, decumbentes y con láminas foliares cortas, duras y dísticas. *B. breviseta* solo fué encontrada en una localidad de México en Chihuahua, aparentemente su distribución se restringe a Texas en EUA y Chihuahua en México.

Distribuición.—Desde Texas al N y Centro de México.

Hábitat.—Se le encuentra en laderas pedregosas y secas, a lo largo de arenas yesosas y calcáreas; 650 a 2700 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Castaños, 5 mi S of Castaños, 3 Sep 1960, 884 m, *J.R. Reeder 3276, C.G. Reeder & T.R. Soderstrom* (TAES, US); 2 km al N de Cañada Blanca, km 17 carr. 57 Saltillo-Monclova, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1481* (CIIDIR, HUAA); Al pie de la Sierra La Gavia, km 117 carr. 57 Saltillo-Monclova, a un lado del Campamento San Lorenzo, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1485* (CIIDIR, HUAA); Municipio de Cuatrociénegas, 19 mi SW of Cuatrociénegas, 6 Sep 1965, 1300 m, *J.R. Reeder & C.G. Reeder 4523* (US), Puerto del Norte, Cuatrociénegas, *L.H. Harvey 1207* (US); 3 mi N of Cuatrociénegas, 28 Oct 1964, 823 m, *J.R. Reeder 3940, C.G. Reeder* (MEXU, TAES); Aprox. 8 km NO de Cuatrociénegas, camino a Ocampo, 12 Ene 1974, 740 m, *J.S. Marroquín 2672* (ANSM); Bolsón de Cuatrociénegas, 21 km S de Cuatrociénegas, carretera 30 Cuatrociénegas-San Pedro de las Colonias, a orillas de la Sierra de San Marcos, 17 Sep 1993, 850 m, *J.A. Villarreal 7255, M.A. Carranza & R. Rodríguez* (ANSM); Ladera baja de la Sierra de San Marcos, frente a las dunas de Cuatrociénegas, 24 Jun 1989, 950 m, *A. Rodríguez 1111, M. Martínez & J.M. Sosa* (ANSM); 24 Jun 1989, 800 m, *A. Rodríguez 1220, N. Moreno & J.J. López* (ANSM); Laderas de la Sierra de San Marcos 24 mi SO Cuatrociénegas, 23 Sep 1990, 750 m, *P.M. Peterson 10012, C.R. Annable & J. Valdés-Reyna* (ANSM, US); Sierra de San Salvador, carretera San Pedro-Cuatrociénegas, 12 Ene 1974, 1350 m, *J.S. Marroquín s.n.* (ANSM); Tip of Sierra de San Marcos, NE-facing slope, 8 Jul 1968, *DJ. Pinkava 5110, E. Lehto & D. Keil* (MEXU); Municipio de General Cepeda, Carretera a Paila, llanura, 24 Sep 1973, 1140 m, *Clase de Botánica* (ANSM); Near La Rosa, O of Saltillo, 9 Oct 1964, 1350 m, *J.R. Reeder & J. Morrow* s.n. (TAES); Ejido La Rosa, carretera 40 Saltillo-Torreón, aprox. 20 km NE de General Cepeda, 5 Jul 1986, 1500 m, *S. Vásquez 100, A. García* (ANSM); Sierra de la Paila al O en el Ejido Nueva Imagen, 5 Oct 1985, 1400 m, *A. Rodríguez 1461* (ANSM, CIIDIR); km 45 carr. 40 Saltillo-Torreón, en la desviación a Gral. Cepeda, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1479* (CIIDIR, HUAA); Road from Puerto del Caballo easterly, 16 km, across the broad valley to the low hills at Tanque Jerico, 22 Aug 1941, *I.M. Johnston 8319* (MEXU); Municipio de Monclova, 25 mi S de Monclova, *I.M. Johnston 7200* (US); Monclova, *C.G. Pringle 414* (US); Municipio de Muzquiz, 7.2 mi SE of Jaboncillos on road towards Cuesta de malena and Melchor Muzquiz, 01 Sep 2006, 1010 m, *P.M. Peterson 19854, S. Lara-Contreras* (US); Municipio de Ocampo, Laguna de La Leche, 22 Jun 178, 1000 m, *J. Valdés-Reyna 1333, H. Garza & L.E. Rodríguez* (ANSM); Rancho experimental La Rueda, 87 km NE de Ocampo, brecha Ocampo-Boquillas del Carmen, Sep 1976, 1580 m, *R. Vásquez 76 & E. Ruíz* (ANSM); Sep 1976, 1400 m, *R. Vásquez s.n.* (ANSM); 2 Jul 1991, 1350 m, *M. Vásquez s.n.* (ANSM); Rancho Las Gallinas, aproximadamente 43 km de Ocampo rumbo a Sierra Mojada, 2 Oct 1990, 1300 m, *M.A. Carranza 569, F.J. Carranza* (ANSM); Sierra de la Madera, Rancho Laguna de la Leche, aproximadamente 62 km de Ocampo rumbo a Sierra Mojada, 2 Oct 1990, 1000 m, *M.A. Carranza 615, F.J. Carranza* (ANSM); Municipio de Parras, Ejido 7 de Enero, 28 Aug 1982, 1450 m, *L.E. Rodríguez s.n.* (ANSM); La Peña, Ejido 4 de Marzo, 6 Aug 1976, 1170 m, *F.A. Roing 129* (ANSM); Municipio de Parras, 11 Sep 1993, 1310 m, *G.B. Hinton 23189* (ANSM); Sierra de Parras, 29 Sep 1978, 1850 m, *J. Valdés-Reyna 1354, M.A. Capó* (ANSM); Sierra de Parras aprox. 2 km SO del Ojo de Agua, 15 Sep 1980, 1800 m, *A. Rodríguez 255*^{a}, *M. Martínez* (ANSM); Sierra de Parras, aprox. 6 km SO del Ojo de Agua, 30 Ene 1981, 1750 m, *A. Rodríguez 184* (ANSM); Municipio de Piedras Negras, 26 mi N de Saltillo, camino a Piedras Negras, *M.C. Johnston 5870*^{a} (US); Municipio de Ramos Arizpe, km 30, carr. 40 Saltillo-Monterrey, en Ramos Arizpe, *Y. Herrera Arrieta & A. Cortés 1454* (CIIDIR, HUAA); 15 km N de Saltillo, carretera 57 Saltillo-Monclova, 22 Aug 1984, 1200 m, *J.A. Villarreal 2654, M.A. Carranza & J. Webbe* (ANSM, CHAPA); Cañada el Diente, Sierra de la Paila, 19 Sep 1989, 1300 m, *J.A. Villarreal 5189, M.A. Carranza* (ANSM); Ejido Alto de Norias, 14 Sep 1973, 1200 m, *Clase de Botánica s.n.* (ANSM); Rancho Las Sabanier, aprox. 6 km E de Ramos Arizpe, 20 Oct 1989, 1500 m, *P.M. Peterson 8441, J. Valdés-Reyna & A. Rodríguez* (ANSM); 23 Sep 1988, *A. Rodríguez 1916, J. Valdés-Reyna & M. Martínez* (ANSM); 19 Oct 1989, 1410 m, *P.M. Peterson 8441, J. Valdés-Reyna & P.A. Fryxell* (US); San Juan de las Bonitas, 19 Jul 1993, 1450 m, *E. Pérez 23* (MEXU); Sierra de la Paila, campo experimental de La Sauceda, 19 Oct 1972, 1650 m, *J.S. Marroquín 2334* (ANSM); Municipio de Sacramento, 10 km de Sacramento rumbo a Cuatrociénegas, 30 Sep 1989, 650 m, *A. Rodríguez 1230, N. Moreno & J.J. López* (ANSM); 10 km de Sacramento rumbo a Cuatrociénegas, 30 Sep 1989, 650 m, *A. Rodríguez 1231, N. Moreno & J.J. López* (ANSM, CHAPA); Municipio de Saltillo, Saltillo, *E. Palmer 404* (US); 12 km O de Saltillo, carretera 40 camino a La estación de Microondas Vega, 9 Jul 1983, 2000 m, *J. Valdés-Reyna 1533, L.E. Rodríguez* (ANSM); 6 mi O of Saltillo along highway 40 toward Torreón, 25 Aug 1983, 1680 m, *S.L. Hatch 5042, J. Valdés-Reyna* (ANSM); Cerro del Pueblo, O de la Ciudad de Saltillo, 11 Sep 1990, 1650 m, *J. Valdés-Reyna 2052, M. Martínez & M.A. Carranza* (ANSM, CHAPA); Buenavista, Saltillo, *A. Rodríguez 131* (ANSM); Municipio de San Pedro, About 12 km airline NNO of Las Delicias on the E face of a small Sierra, 25 Sep 1972, 1000 m, *M.C. Johnston 9530, F. Chiang & T.L. Wendt* (ANSM); 5.5 km al NW de Nueva Delicias, vertiente E de la Sierra de las Delicias, al N de San Pedro de las Colonias, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1490* (CIIDIR, HUAA); Al SW de Coahuila, (límites con Durango-Chihuahua), *D. López 16* (CHAPA); Municipio de Sierra Mojada, San Antonio de los Alamos, E base of the Volcanic Sierra de San Antonio, 20 Aug 1941, *I.M. Johnston 8249* (MEXU); Municipio de Torreón, Cañón Picardias, 2 km antes de Juan Eugenio, Torreón, *J.A. Villarreal, M.A. Carranza, A. Orta & J. Elizondo 2276* (CIIDIR); 11.7 km E of Flor de Jimulco at an abandoned mine, 21 Oct 1989, 1730 m, *P.M. Peterson 8456, J. Valdés-Reyna, J.A. Villarreal & P.A. Fryxell* (US); 10 mi S de Jimulco, *F. Shreve 9414* (US); Sierra de Jimulco, proximidades al ejido La Trinidad, 25 Aug 1988, 1900 m, *J.A. Villarreal 4411, M.A. Carranza & A. Rodríguez* (ANSM, CIIDIR, IEB); Municipio de Torreón, Sierra El Rosario, carr 49, 30 km al SE de Lerdo, Dgo., *J.A. Villarreal 5803, M.A. Carranza* (ANSM); Municipio de Zaragoza, 16.9 km NE of San Miguel on road to Boquillas, 13 Sep 1991, 1180 m, *P.M. Peterson 10612, C.R. Annable* (US). Nuevo León. Municipio de Galeana, 8 km al entronque de San Roberto, rumbo a Galeana, *Y. Herrera Arrieta & A. Cortés 1449* (CIIDIR, HUAA); Municipio de Monterrey, Carr. Villa de García a Grutas, W de Monterrey, *T. Tateoka 1087* (US). **Tamaulipas:** Municipio de Miquihuana, Ejido El Aserradero, 4 Sep 1988, 2700 m, *R.A. Carranco 81* (MEXU).

18. Bouteloua repens (Kunth) Scribn., Bull. Div. Agrostol., U.S.D.A. 4:9. 1897. (**Fig. 24**). *Dinebra repens* Kunth, Nov. Gen. Sp. (quarto ed.) 1:172. t. 52. 1816. *Atheropogon repens* (Kunth) Roem. & Schult., Syst. Veg. 2:416. 1817. *Eutriana repens*

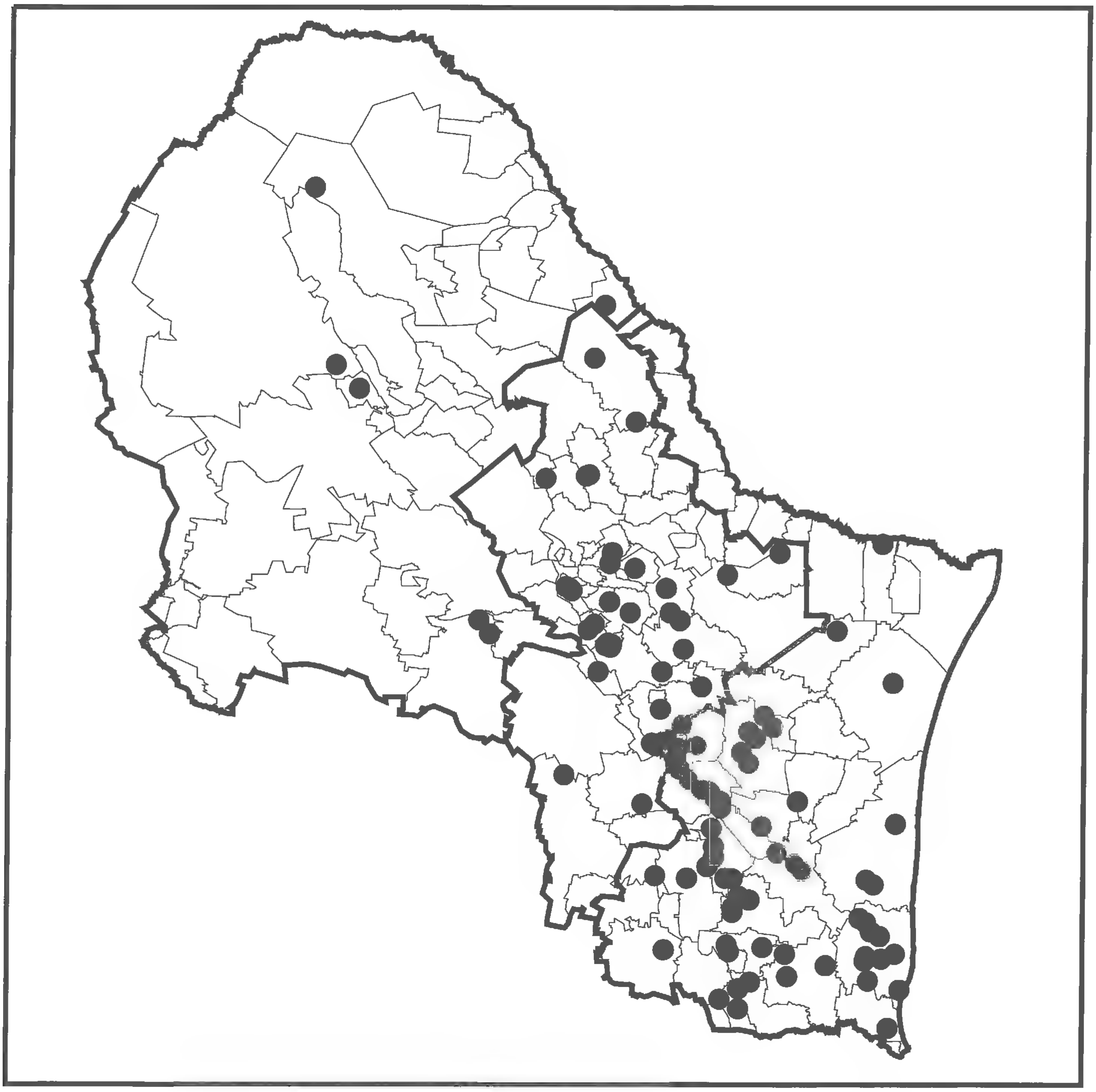


Fig. 24. Distribución de *Bouteloua repens* en el noreste de México.

(Kunth) Trin., Gram.Unifl. Sesquifl. 241.1824. Tipo: MÉXICO. Guerrero: Acapulco, "Crecit ad litora Ocwani Pacifici prope," F *Humboldt & A. Bonpland s.n.* (lectotipo: P, designado por McVaugh, Fl. Novo-Galiciana 14:91. 1983 en nombre solo).

Heterosteca juncifolia Desv., Nouv. Bull. Sci. Soc. Philom. Paris 2:188.1810. *Eutriana heterostega* Trin., Gram. Unifl. Sesquifl. 242.1824 (basado encendido *Heterosteca juncifolia* Desv., bloqueado cerca *Bouteloua juncifolia* Lag.). *Atheropogon juncifolius* (Desv.) Spreng., Syst. Veg. 1:294. 1825. *Eutriana juncifolia* (Desv.) Kunth, Revis. Gramin.1:95. 1829. *Dinebra juncifolia* (Desv.) Steud., Nomencl. Bot. (ed. 2) 1:510. 1840. *Bouteloua humboldtiana* Griseb., Mem. Amer. Acad. Arts, n.s. 8:532. 1862 (basado encendido *Heterosteca juncifolia* Desv., bloqueado cerca *Bouteloua juncifolia* Lag.). *Bouteloua heterostega* (Trin.) Griffiths, Contr. U.S. Natl. Herb. 14(3):414, f. 59. 1912. Tipo: CUBA: La Habana, "Habitat in Antillis," *A. Bonpland 132B* (holotipo: P-DESV; isotipo: US-2830954 fragm.!).

Bouteloua bromoides Lag., Gen. Sp. Pl. 5.1816. *Actinochloa bromoides* (Lag.) Roem. & Schult., Syst. Veg. 2:420. 1817. *Eutriana bromoides* (Lag.) Trin., Gram. Unifl. 241. 1824. Tipo: MÉXICO. Guerrero: Acapulco (holotipo: MA; isotipo: US-865568 fragm.!).

Atheropogon filiformis E. Fourn., Mexic. Pl. 2:140. 1886. *Bouteloua filiformis* (E. Fourn.) Griffiths, Contr. U.S. Natl. Herb. 14(3):413, 1912. Tipo: MÉXICO: "Hacienda de la Naranja," *Karwinski 991b* (lectotipo: LE, designado por McVaugh, Fl.-Galiciana 14:91. 1983 en nombre solo).

Heterosteca rhadina Nash, Bull. Torrey Bot. Club 30:386. 1903. Tipo: PUERTO RICO: Near Ponce, 18 Nov 1902, *A.A. Heller 6057* (holotipo: NY-71113!; isotipo: US-426292!).

Bouteloua pubescens Pilg., Verh. Bot.Vereins Prov.Brandenburg 51:193. 1909. Tipo: GUATEMALA. Depto. Huehuetenango: Malactan, 13 Nov 1896, *E. Seler 3224* (isotipo: US-81707 fragm.!).

Plantas perennes, amacolladas. Culmos de 20 a 60 cm de alto, erectos o esparcidamente ramificados en el tercio inferior a abierto-decumbentes, generalmente débiles, partiendo de una base firme y nudosa; entrenudos y nudos glabros a escasamente hirsutos. Vainas glabras, diminutamente hirsutas o con algunos pelos dispersos; lígula de 0.2 a 0.5 mm de largo, un anillo de cilios blancos; láminas foliares de 4 a 12 cm de largo y de 2 a 3(–5) mm de ancho, lineares, aplanadas, glabras o escasamente hirsutas, con pelos de base papilosa de 2 a 4 mm de largo, cerca de la base y en el margen. Inflorescencia de 5 a 10 (14) cm de largo, largamente exserta, solitaria, terminal, con 7 a 10 ramificaciones primarias espigadas caedizas en la madurez; espigas de 1.5 a 2.5 cm de largo, ascendentes a patentes, espaciadas a lo largo del eje, pero apiñadas hacia el ápice de la inflorescencia, cuneadas en la base, portando 6 a 10(–12) espiguillas, densamente imbricadas en la mitad inferior del raquis. Espiguillas de 6 a 9 mm de largo, congestas, permanecen insertas; glumas anchas, agudas, de color púrpura, primera gluma de 4 a 7 mm de largo, hispida en la quilla, con el ápice mucronado a ligeramente bífido, segunda gluma de 6 a 9 mm de largo, más ancha, glabra, con el ápice mucronado; lema de la flor perfecta de 5 a 9 mm de largo, glabra, rara vez barbada en la base, con 3 aristas cortas, hasta de 1 mm de largo, la central más fuerte y larga, ligeramente escabrosa; pálea de 4.5 a 8 mm de largo, glabra a finamente estrigosa hacia el ápice, las nervaduras proyectándose en 2 pequeñas aristas del mismo tamaño que las de la lema o un poco mayor. Anteras de 3.5 a 5.5 mm de largo, color anaranjado, amarillas o rojizas. Flósculo rudimentario 1, bien desarrollado, estaminado; lema del flósculo de 5.5 a 7 mm de largo, incluyendo las 3 aristas, aristas de 2 a 10 mm de largo, la central fuerte y escabrosa, las laterales más cortas, la mitad del tamaño o un poco más largas que el cuerpo de la lema. Cariopsis de 2.4 a 3 mm de largo, ovoide a estrechamente elíptica. $2n = 20, 40, 60$. Florece de agosto a noviembre.

Distribución.—S de Estados Unidos hasta todo México; Antillas: Cuba, Haití, Puerto Rico y República Dominicana.

Hábitat.—En terrenos abiertos de pastizales, planicies o laderas sobre suelos arenosos o pedregosos, en bosques de encino, de pino, pastizales y matorrales xerófilos; 50 a 1600 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Cuatrociénegas, Entrada al Casco del Rancho Potrero de Menchaca, 30 Aug 1980, 1600 m, *R. Vásquez* 19^a, *L.E. Rodríguez* (ANSM); Municipio de Hidalgo, Entre el Coyote y Palo Blanco, Oct 1976, *F. González 6309, R.M. López & R. Hernández* (MEXU); Rancho Santa Barbara, 28 Nov 1989, 190 m, *J.A. García s.n.* (UAT); Municipio de Saltillo, N of Saltillo on Mex 57, N of Lazaro Pass, and 0.5 km S of La Muralla Restaurant, 13 Oct 1989, 1150 m, *P.M. Peterson 8379 & J. Valdés-Reyna* (US). **Nuevo León:** Municipio de Allende, Río Ramos, 1 km S de Allende, carretera 85, 29 Oct 1992, 405 m, *J.A. Villarreal 6789, M. Vásquez, D.E. Lozano & J. Valdés-Reyna* (ANSM); Río Ramos, 4 km S de Allende, carretera 85, 24 Oct 1986, 460 m, *J. Espinosa s.n.* (ANSM); Río Ramos, 1 km al S de Allende, *J.A. Villarreal, M.Vázquez, D.E. Lozano & J. Valdés-Reyna s.n.* (CHAPA); 9 mi N of Allende on Mex 85, *J. Brunken & C. Perino 180* (CHAPA); Entre Montemorelos y Allende, *F.W. Gould 9822* (US); Municipio de Anáhuac, La Gloria, Jul 1978, 180 m, *G. Villegas 241, Flores* (MEXU); Municipio de Bustamante, Grutas de Bustamante, 18 Jun 1993, 1300 m, *P. Jauregui 76* (MEXU); Municipio de Cadereyta Jiménez, Carretera a Reynosa, 2 km O de la Refinería Cadereyta, 26 Sep 1979, 320 m, *J.A. Villarreal & J. Valdés-Reyna* (MEXU); Municipio de Cerralvo, Puerta de entrada del Rancho Tinajas a 5 km de la carretera Doctor González-Cerralvo, 14 Feb 1987, 540 m, *P.A. García 1879* (MEXU); Municipio de Doctor González, Carretera Doctor Gonzalez-Cerralvo, km 52, 19 May 1993, 400 m, *N. Bazaldua 80* (MEXU); Municipio de Galeana, El Saucito camino a Galeana Linares, Nov 1980, 600 m, *J.A. Ochoa 1268* (MEXU); Municipio de General Bravo, General Bravo, Dic 1980, 150 m, *J.A. Ochoa 1161* (MEXU); 30 mi E de Gral. Bravo sobre la carr. a Reynosa, *J. Crutchfield & M.C. Johnston 6056* (US); Municipio de Higueras, Falda de la Loma Higueras frente a las instalaciones de la Unión Ganadera de Higueras, 1 Jul 1993, *P. Jauregui 86* (MEXU); Municipio de Linares, Ejido Los Leones, alt. 250, 18 May 1980, *J.J. Ortíz s.n.* (ANSM); Localizado en el rancho El Nogalar, ubicado en la carretera Linares-San Roberto, km 12, 2 Jun 1993, 440 m, *M.M. Castillo 80* (MEXU); Municipio de Los Ramones, Areas cercanas a la carretera Los Ramones, 14 Abr 1982, 210 m, *J.A. Villarreal 1517* (ANSM); Ejido el Carrizo, 20 Oct 1976, 210 m, *D. Dávila s.n.* (ANSM); Los Ramones, 4 Abr 1985, 210 m, *J.A. Villarreal 2877* (ANSM); Municipio de Marín, Facultad de Agronomía, Universidad Autónoma de Nuevo León, km 17, Marín, 22 Oct 1992, *M.M. Castillo 20* (MEXU); Municipio de Monterrey, Aug 1911, 540 m, *F. Abbon 6245, G. Arsene* (MEXU); Near Monterrey, 26 Jun 1888, *C.G. Pringle s.n.*(MEXU); Valley of Monterrey, 6 Jun 1889, *C.G. Pringle 2547* (MEXU); Monterrey, *B.C. Tharp 1905* (US); 20 km al NW de Montemorelos, S de Monterrey, *J.M. Weaver 588* (US); Near 934 km post, S of Los Flores; along road to Linares, 17 Jul 1955, *H.M. Chute 280* (MEXU); Municipio de Muzquiz, Rancho La Peña, Sierra de Santa Rosa, Muzquiz, *R. Salgado s.n.* (CIIDIR, SLPM); Municipio de Sabinas Hidalgo, Fracción del Río Sabinas, junto al centro recreativo Ojo de Agua de Sabinas Hidalgo, 24 Mar 1993, *N. Bazaldua 41-A* (MEXU); S de Sabinas Hidalgo, *C.H. Mueller 419* (US); Municipio de Saltillo, Buenavista, *A. Ruiz 356* (ANSM); Buenavista, *R. Palomo 357* (ANSM); Municipio de Santiago, Blanquillo, 22 Jun 1994, 370 m, *G.B. Hinton 24439* (MEXU); Xeric O wall of Cañón de Potrero Redondo, 4 Jul 1935, *C.H. Mueller 2108* (MEXU). **Tamaulipas:** Municipio de Aldama, 20 km N of Aldama on the road to Soto La Marina, at the Hacienda La Concepción, 20 Sep 1956, 50 m, *F. Martínez 1792, G. Borja* (MEXU); Camino a la Barra del Tordo, 4 Mar 1987, *P. Moya 205* (MEXU); Camino al Rancho El Olmo, 11 Jun 1992, 260 m, *J.E. López 96* (MEXU); Ejido San Felipe, 11 Jun 1992, 230 m, *J.F. Iribe 349* (MEXU); km 10 a Barra del Tordo, 24 Sep 1980, 160 m, *J. Cantú 2* (MEXU); Poblado Piedras Negras, 13 Sep 1988, 180 m, *J.G. Galván 236* (MEXU); Pozas del ejido El Nacimiento, 5.5 km SO de Aldama, 31 Aug 1984, 260 m, *L. Hernández 1170* (UAT); Rancho La Concepción, 11 Jun 1981, 75 m, *G. Villegas 457* (MEXU); Rancho La Granja, 3 Mar 1987, 180 m, *P. Moya 204* (MEXU); Sierra de Tamaulipas, Region of Rancho Las Yucas, 40 km NNO of Aldama, near Paso Lajas (Ejido Las Yucas), 10 Oct 1957, *R.L. Dressler 2326* (MEXU); Municipio de Altamira, 15 mi from Tampico on the Mante highway, 27 Sep 1959, *M.C. Johnston 4082, J. Graham* (MEXU); Ejido Santa Juana, 23 Oct 1980, 90 m, *J. Cantú 8* (MEXU); Municipio de Antiguo Morelos, Ejido Guadalupe Mainero, 25 Sep 1981, 700, *J.F. Iribe 100* (MEXU); Santa Fé, 19 Aug 1981, 130 m, *J.F. Iribe 58* (MEXU); *J.F. Iribe 795* (IEB); Santa Teresa,19 Aug 1981, *J.F. Iribe* 66 (MEXU); Municipio de Casas, 35 km from Victoria on the road to Casas and Soto la Marina, 3 Oct 1956, 280 m, *F. Martínez F-2350, G. Borja L.* (MEXU); 64 km from Soto la Marina on the (old, winding) road to Casas and Victoria, 4 Oct 1956, 350 m, *F. Martínez F-2361, G. Borja* (MEXU); Rancho La Trinidad, 18 Sep 1984, 220 m, *J.F. Iribe 233* (MEXU); Municipio de Gomez Farías, Entrada al Ejido El Nacimiento, 27 May 1990, 100 m, *M.E. Crespo 304* (ANSM); La Poza Azul, nacimiento del río Frío. Reserva de la Biosfera El Cielo, 25 Aug 1993, 300 m, *J.L. Mora 429* (UAT); Municipio de González, 24.5 km al E de Xicotencatl, 11 Jun 1992, 170 m, *J.G. Galván 271* (MEXU); 5 km al N de González, Mar 1991, 110 m, *G. Bores 140* (MEXU); Ejido Josefa Ortíz de Domínguez, Sep 1983, 380 m, *M.H. Cervera 191* (MEXU); Sep 1983, *C.R. López 91* (MEXU); Orilla Magiscatzin, 3 Mar 1987, 180 m, *J.G. Galván 201* (MEXU); Rancho La Peñita, 21 Sep 1982, 90 m, *J.L. Ramos 83* (MEXU); Municipio de Gómez, La Herradura, 7 Sep 1983, 400 m, *R.A. Carranco 196* (MEXU); La Minita, 18 Aug 1983, 370 m, *J.L. Ramos s.n.* (MEXU); Municipio de Hidalgo, Sierra La Lagunita, 6.4 mi SE of Aramberri on road towards Agua Fría, 19 Sep 2002, 1397 m, *P.M. Peterson 16674, J. Valdés-Reyna & M. Sosa* (US);15 km al SE de Hidalgo rumbo al Barretal, Mar 1969, 230 m, *F. González 2337* (MEXU); 18 km al SE de Hidalgo, *G. Villegas 72* (MEXU); Estación Adelaida, 1 Oct 1986, 200 m, *J.F. Iribe 312* (MEXU); Estación La Cruz, 220 m, *G. Villegas 7, López* (MEXU); Marroquín, 15 Aug 1980, 360 m, *M.H. Cervera 15* (MEXU); Marroquín, 15 Aug 1980, 360 m, *M.H. Cervera 540* (MEXU); Oyama, 21 Oct 1976, 220 m, *G. Villegas 27* (MEXU); San Francisco, 21 Feb 1985, 280 m, *R. Díaz 288* (UAT); Municipio de Jaumave, Altas Cumbres km160 carretera Victoria-Jaumave, 29 Jun 1985, 950 m, *M. Martínez & Díaz 742* (UAT); Ejido La Unión, 9 Oct 1985, *J.F. Iribe 241* (MEXU); Municipio de Jiménez, 11 mi from Santander Jiménez on the road to Padilla, 20 Oct 1959, *M.C. Johnston 4395, J. Graham* (MEXU); Carretera Padilla-Jiménez, 23 Nov 1981, 210 m, *J.L. Ramos 44* (MEXU); Municipio de Llera, About 30 mi S of Ciudad Victoria on highway 85, toward Ciudad Mante, 28 Sep 1976, 460 m, *F.W. Gould 14814* (ANSM, CHAPA); Ejido Portes Gil, 8 Sep 1981, 180 m, *J.A. Barrientos 93* (MEXU); *L.H. Harvey & J. Witherspoon 9215* (ENCB); km55 carretera Victoria-Llera, 23 Sep 1986, *P. Moya151* (COCA, IEB); Municipio El Mante, Between Cd. Mante and Tampico, 10 mi S, village of Granja Trinidad, *A.A. Beetle M-1220, M. May, Q. Skinner, A. Ibarra, J. Bradley & F. Loeper* (CHAPA); Irrigation ditches on south side of Cd. Mante, *A.A. Beetle M-1187* (CHAPA); 10 mi al S de Cd. Mante, *F.W. Gould 9552* (US); Municipio de Mainero, Ejido Boreal Real, 25 Jul 1986, 750 m, *J.G. Galván 118* (MEXU); km 5 hacia El Ejido Camarones, 25 Jul 1986, 750 m, *J.G. Galván 127, 128* (MEXU); La Oveja (Venustiano Carranza), 19 Nov 1986, 1800 m, *M. Cisneros 103* (MEXU); Municipio de Méndez, San Tomás, 18 Sep 1980, 110 m, *R.A. Carranco 17* (MEXU); Santo Tomás, 110 m, *R.A. Carranco 630* (MEXU); Municipio de Miquihuana, El Angelito, Colonia La Peña, 24 Nov 1981, 660 m, *J.A. Barrientos 1267* (MEXU); Municipio de La Tamaulipeca. Vicinity of the San Miguel, 26 Jul 1930, *B.H. Harris 10601* (MEXU); Municipio de Nuevo Morelos, Sierra de Tamalave, 3 Aug 1981, 550 m, *J.F. Iribe 69* (MEXU); Municipio de San Carlos, 1 km al O de San Carlos hacia la Unión Morales, 26 Jun 1994, *M. Martínez & Díaz de Salas 2695* (MEXU); Ejido el Corralejo, 21 Aug 1980, 320 m, *J.F. Iribe 7* (MEXU); Ejido el Corralejo, Aug 1980, 270 m, *G. Villegas 420* (MEXU); Ejido La Gavia, 3 Sep 1981, 300 m, *J.A. Barrientos 73* (MEXU); Rancho Loma Atravesada, 25 Jun 1992, 380 m, *J.F. Iribe 375* (MEXU); Sierra de San Carlos. La Morita, 26 Jun 1930, 533 m, *B.H. Harris 1933* (MEXU); Municipio de San Nicolás, Entre San José del Alto (Las Adjuntas) y el Palmar, 1 Mar 1970, 700 m, *F. González 2781, V.M. Toledo & E. Martínez* (MEXU); Rancho La Trinidad, 19 Oct 1983, 650 m, *J.F. Iribe 202* (MEXU); Municipio de Soto la Marina, Ejido Benito Juárez, 3 Oct 1986, *J.F. Iribe 322* (MEXU); Entre Lavaderos y la Piedra, 18 Sep 1981, 140 m, *A. Brito 9* (MEXU); Tramo San José de las Rusias-Ejido 5 de Mayo, 2 Oct 1986, 80 m, *J.G. Galván 156* (MEXU); Municipio de Tula, Ejido La Laguna, 6 Nov 1986, 1150 m, *P. Moya 166* (MEXU); Municipio de Victoria, Camino al Ejido La Reforma, 23 Oct 1986, 700 m, *G. Bores 118* (MEXU); Camino al Molino, 3 Sep 1986, 500 m, *R.A. Carranco 247* (MEXU); 18 Nov 1986, 1000 m, *J.E. López de la Cruz 27* (MEXU); Cañon del Novillo. Río San Marcos, 23 Jun 1989, 440 m, *A. Mora 857* (UAT); Municipio de Victoria, Ejido Vicente Guerrero, 6 Sep 1985, 800 m, *M.H. Cervera 276* (MEXU); Ex-Hacienda de Nogales, Aug 1986, 340 m, *P. Moya 116, 117* (MEXU); Rancho El Abra, 18 Sep 1985, *J.G. Galván 82* (MEXU); Municipio de Villagrán, 3 mi S of Nuevo León line on the Villagrán-Linares highway, 12 Nov 1959, 457 m, *M.C. Johnston 4660, J. Graham* (MEXU); Ejido Candelario Reyes, 15 Oct 1985, 500 m, *J.F. Iribe 250* (MEXU); Ejido Guadalupe, 28 Jun 1983, 360 m, *J.F. Iribe 170* (MEXU); Ejido Guadalupe, 22 Oct 1985, 380 m, *J.F. Iribe 255* (MEXU); Garza Valdéz, 19 Nov 1986, 290 m, *J.G. Galván 192* (MEXU); La Huasteca, 24 Jul 1983, 450 m, *M. H. Cervera 172* (MEXU); La Huasteca, 24 Aug 1983, 450 m, *J.F. Iribe 174* (MEXU); On highway 85, between Linares and Ciudad Victoria, 111 km NO of Ciudad Victoria, 24 Jun 1977, 415 m, *T.B. Croat 3917*^{a} (MEXU); Municipio de Xicoténcatl, Ejido Emiliano Zapata, 4 Feb 1981, *J.F. Iribe 51* (MEXU); Jul 1979, *A. Bolaños 7* (MEXU).

19. Bouteloua rigidiseta (Steud.) Hitchc., J. Wash. Acad. Sci. 23(10):453. 1933. (**Fig. 25**). *Aegopogon rigidisetus* Steud., Syn. Pl. Glumac. 1:146. 1854. Tipo: U.S.A. Texas: 1856, *Drummond 374* (holotipo: P; isotipos: US-879824 fragm. ex P!, US-1063200 fragm. ex E!).

Bouteloua texana S. Watson, Proc. Amer. Acad. Arts 18:196. 1883. *Polyodon texanus* (S. Watson) Nash, Fl. S.E. U.S. 138, 1327. 1903. Tipo: U.S.A. Texas: San Antonio de Bejar, *Berlandier 1535* (lectotipo: GH, designado por Griffiths, Contr. U.S. Natl. Herb. 14:404. 1912).

Plantas perennes, amacolladas. Culmos de 15 a 40(–50) cm de alto, delgados, débiles, erectos, muy esparcidamente ramificados en la base. Hojas principalmente basales; vainas glabras a ligeramente escabrosas; lígula de 0.1 a 0.5 mm de largo, un anillo corto de cilios; láminas foliares de 4 a 10(–17) cm de largo y 1 a 2 mm de ancho, generalmente aplanadas, en ocasiones los ápices involutos, terminando en un ápice muy fino, glabras a finamente papiloso-pilosas, pelos de 1 a 1.5 mm de largo. Inflorescencia de 3 a 6 cm de largo (solo donde se insertan las ramificaciones), con 5 a 14 ramificaciones primarias espigadas caedizas, articulación de las espigas es 0.5 mm por arriba de la base, dejando un pequeño trozo persistente sobre el eje principal; ramificaciones de 4 a 7(–9) mm de largo, portando (2–)3 a 5 espiguillas; raquis característicamente rígido, con el ápice aristado, profundamente trifurcado a bifurcado, las aristas laterales antrorsas. Espiguillas de 7 a 10 de largo, incluyendo las aristas, flabeladas; glumas desiguales, primera gluma de 3 a 4 mm de largo, segunda gluma de 6 a 8 mm de largo, diminuto plateado-pubescente en las nervaduras, lanceolada, acuminada, corto aristada; lema de la flor perfecta de 4 a 5 mm de largo, sin incluir las aristas, esparcido-pubescente en las nervaduras, terminando en 2 aristas laterales escabrosas, divergentes, de 2 a 3 mm de largo, y 1 central más fuerte, de 3 a 4(–5) mm de largo; pálea de igual tamaño que el cuerpo de la lema, glabra, con el ápice bífido. Anteras de 2.5 a 3 mm de largo, blanco-amarillentas. Flósculo rudimentario 1(–2), el primero reducido a una columna 3-aristada, las aristas de 5 a 10 mm de largo, aplanadas, fuertes, escabrosas, alternas con 2 lóbulos intermedios, de 3 a 4 mm de largo, corto aristados; segundo flósculo cuando presente, similar al primero pero más pequeño. Cariopsis de 3.5 a 3.7 mm de largo, estrechamente ovobada, aplanada. *2n*= 28, 35, 40 (para localidades de EUA). Ha sido colectado en diferentes meses a través del año.

Distribución.—SE de Estados Unidos a México en Coahuila y Tamaulipas.

Hábitat.—Pastizales y lugares abiertos de bosques, sobre suelos arcillosos o areno-arcillosos; 115 a 1400 m.

Ejemplares examinados. **MÉXICO: Tamaulipas:** Municipio de González, 24 km al NO de González, 11 Jun 1992, 115 m, *P. Larraga 6* (MEXU); Municipio de Jiménez, Ejido Sor Juana Inés de la Cruz, 29 Sep 1993, 150 m, *J.G. Galván 338* (MEXU); Municipio de Soto la Marina, km 10 carretera a Soto la Marina-Abasolo, 10 Oct 1991, 60 m, *O.M. Galván 503* (MEXU); Municipio de Victoria, El Madroño, 17 Mar 1994, 1400 m, *J.G. Galván 358* (MEXU); El Refugio, 17 Mar 1994, *J.F. Iribe 429* (MEXU); Victoria-Altas Cumbres, 21 Jul 1993, 1200 m, *J.A. Franco 139* (MEXU).

20. Bouteloua scorpioides Lag., Gen. Sp. Pl. 5. 1816. (**Fig. 26**). *Actinochloa scorpioides* (Lag.) Roem. & Schult., Syst. Veg. 2:420. 1817. *Atheropogon scorpiodes* (Lag.) Spreng., Syst. Veg. 1:293. 1825. *Chondrosum scorpioides* (Lag.) Kunth, Revis. Gramin. 1:94. 1829. Tipo: MÉXICO: "Habitat in N. Hisp.," *Sessé s.n.* (holotipo: MA?).

Plantas perennes, formando pequeños macollos o manchones. Culmos de 10 a 20(–30) cm de alto, delgados, erectos, poco ramificados en la base, glabros a ligeramente puberulentos cerca de los nudos. Hojas principalmente basales; vainas glabras, con márgenes hialino-pubescentes y un mechón de pelos en la garganta, los pelos de 1.5 a 3 mm de largo; lígula de 0.5 a 1 mm de largo, ciliada; láminas foliares de 2.5 a 13 cm de largo, involutas, curvadas o flexuosas, escabroso-pubescentes del lado adaxial. Inflorescencia corta, con un eje de aproximadamente 1 mm de largo, portando una ramificación primaria espigada persistente; raquis claramente arqueado, glabro a escabroso; ramificación de 2.5 a 4(–5) cm de largo, unilateral, inserta en el ápice del culmo, en ocasiones presenta una bráctea estrecha hasta de 7 mm de largo, portando 35 a 90 espiguillas, distribuidas hasta el ápice del raquis. Espiguillas de 5 a 7 mm de largo, articulación por arriba de las glumas; glumas subagudas, glabras a escabrosas, verdes o con tintes purpúreos, primera gluma de 2 a 3 mm de largo, angosta, segunda gluma de 4 a 7 mm de largo, glabra a escabrosa; lema de la flor perfecta de 3.5 a 5.5 mm de largo, barbada en la base y densamente pilosa sobre los márgenes y nervaduras en la mitad inferior, los nervios se prolongan en aristas fuertes de 1.5 a 2 mm de largo la central y 1 a 1.5 mm las

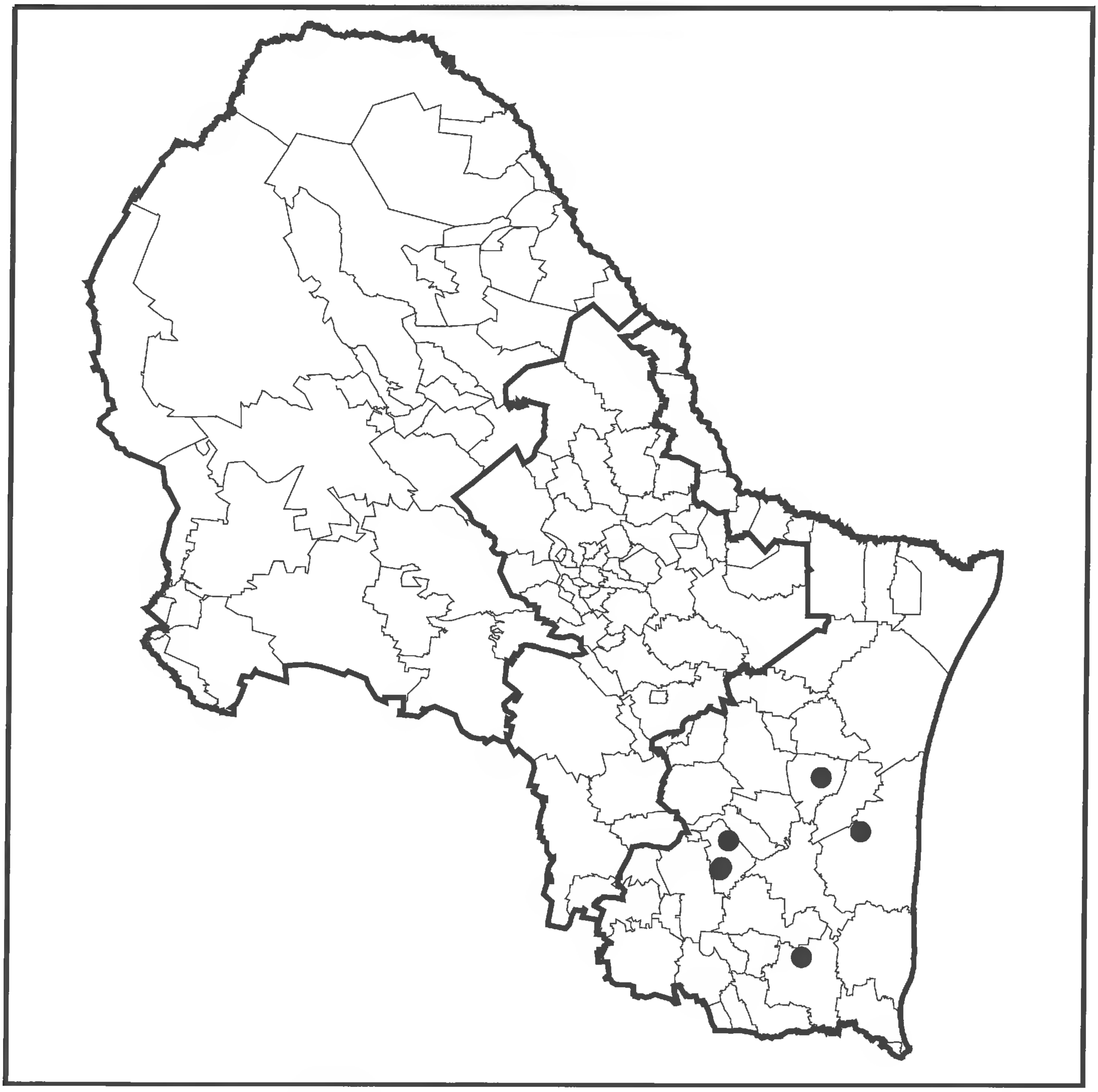


Fig. 25. Distribución de *Bouteloua rigidiseta* en el noreste de México.

laterales. Anteras de 2.8 a 3 mm de largo, color anaranjado. Flósculos rudimentarios 2, el primero de 5.5 a 6 mm de largo, con 3 aristas de 1.5 a 4 mm de largo, con un mechón de pelos en la base; segundo flósculo muy reducido. Cariopsis de 1.8 a 2.4 mm de largo, color amarillo a café, anguloso- triangular. 2*n* = 20. Florece aparentemente de agosto a diciembre, aunque se le encuentra en otras épocas del año.

Distribución.—Especie mexicana distribuida del N al Centro del país.

Hábitat.—Laderas rocosas con pastizal y matorral xerófilo; 1750 a 2300 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Monterrey, 25 mi SW de Monterrey, *F.A. Warnock 14820* (US); Municipio de Piedras Negras, Cerca de Díaz, *F.A. Barkley 14820* (US). **Nuevo León:** Municipio de Aramberri, 16 km NE of Sandia on road to La Ascension, 19 Sep 2001, 2000 m, *P.M. Peterson 15829, J. Valdés-Reyna* (US); Municipio de Doctor Arroyo, Doctor Arroyo, Nov 1980, 1750 m, *J.A. Ochoa 1267* (MEXU); El Jarro, 16 km al O de Doctor Arroyo, en laderas calizas, Oct 1972, 1850 m, *F. González 4956, M.A. Capo & M. Sánchez* (MEXU); 9.4 mi W of San Antonio de Peña Nevada & 0.4 mi E of jct of Hwy 2 to Or., 22 Sep 2002, 1807 m, *P.M. Peterson 16794, J. Valdés-Reyna & M. Sosa* (US); Municipio de Galeana, Región de Galeana, *E. Hernández & V. Mathus N-2046* (CHAPA); 14 mi al N de Matehuala, *J.R. Reeder & C.G. Reeder 3661* (US); 8 km al entronque de San Roberto, rumbo a Galeana, *Y. Herrera Arrieta & A.*

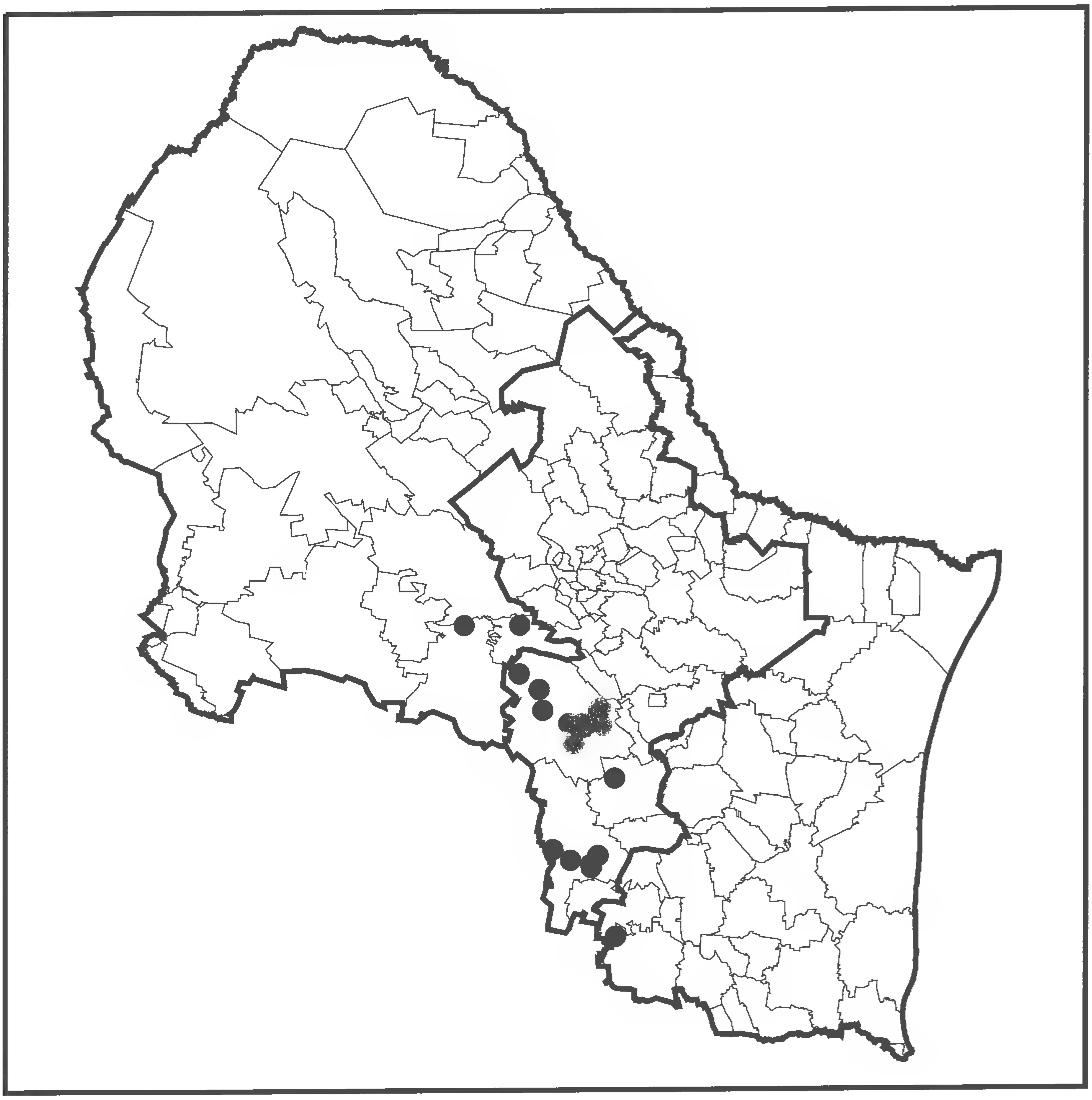


FIG. 26. Distribución de *Bouteloua scorpioides* en el noreste de México.

Cortés 1448 (CIIDIR, HUAA); km 150, carr. 57 Matehuala-Saltillo, a 20 km de San Roberto, *Y. Herrera Arrieta & A. Cortés 1450* (CIIDIR, HUAA); km 162, carr. 57 Matehuala-Saltillo, *Y. Herrera Arrieta & A. Cortés 1452* (CIIDIR, HUAA); 12 km E de entronque San Roberto sobre la carretera 58 camino a Galeana, 5 Sep 1986, 2300 m, *J. Valdés-Reyna 1719, R. Banda* (ANSM, IEB); 12 km SE of San Roberto on highway 58, 27 Aug 1981, 1845 m, *S.L. Hatch 4579, C.W. Morden & J. Valdés-Reyna* (ANSM); 12.3 mi S of Milagro, 18 Sep 2003, 2040 m, *P.M. Peterson 17809, J. Valdés-Reyna & H.S. Hinton* (US); 2 km S del Salero, 1 km E de carretera 57 Matehuala-Saltillo, 3 Jul 1983, 2050 m, *J. Valdés-Reyna 1624, J.S. Marroquín* (ANSM); Along highway 57, about 12 mi N of San Roberto, 4 Sep 1991, 1768 m, *K.W. Allred 5512, J. Valdés-Reyna & J.T. Columbus* (ANSM): Rancho Aguililla, 17 Sep 1989, 1950 m, *G.B. Hinton 19740* (MEXU); Municipio de Tula, La Tapona, 21 Oct 1982, 1900 m, *M.H. Cervera 134-A* (MEXU).

21. Bouteloua simplex Lag., Varied. Ci. 4:141. 1805. (**Fig. 27**). *Actinochloa simplex* (Lag.) Roem. & Schult., Syst. Veg. 2:418. 1817. *Chondrosum simplex* (Lag.) Kunth, Revis. Gramin. 1:94. 1829. TIPO: PERU: *Née s.n.*?(HOLOTIPO: MA; ISOTIPOS: M, LE-TRIN-2127.02!).

Chloris procumbens P. Durand, Quib. Chlor. Spec.16. 1808. *Chondrosum procumbens* (P. Durand) Desv., Nouv. Bull. Sci. Soc. Philom. Paris 2:188. 1810. *Chondrosum procumbens* (P. Durand) Desv. ex P. Beauv., Ess. Agrostogr. 1:41, 158, t. 9, f. 7. 1812. *Atheropogon*

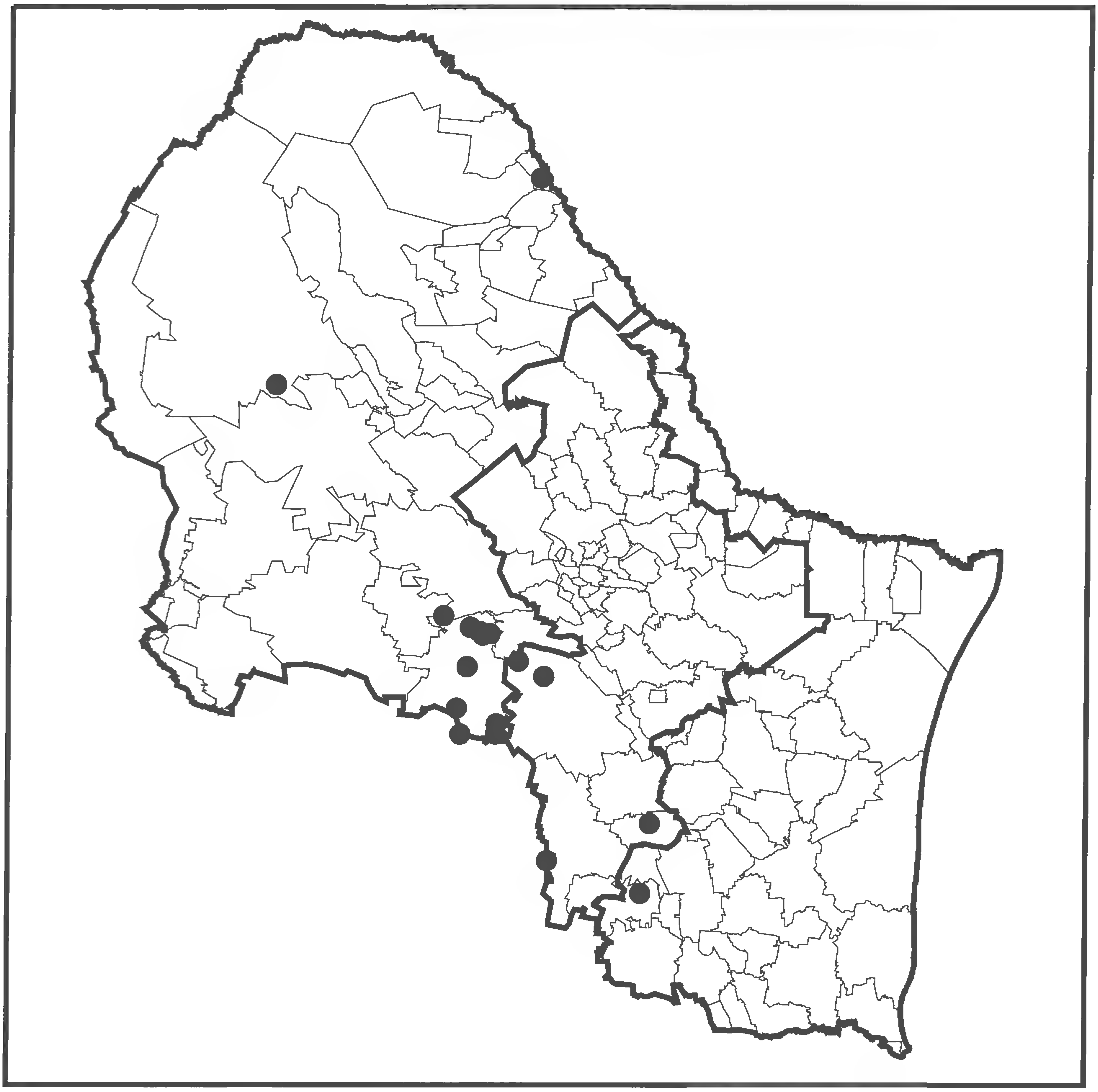


Fig. 27. Distribución de *Bouteloua simplex* en el noreste de México.

procumbens (P. Durand) J. Jacq., Ecl. Gram. Rar. 2:16, pl. 12. 1813. *Actinochloa procumbens* (P. Durand) Roem. & Schult., Syst. Veg. 2:417. 1817. *Cynodon procumbens* (P. Durand) Raspail, Ann. Sci. Nat. (Paris) 5:303. 1825. *Bouteloua procumbens* (P. Durand) Griffiths, Contr. U.S. Natl. Herb. 14(3):364, f. 27. 1912. Tipo: PHILLIPINES: Cultivated at Madrid, probably from México or South America, *P. Durand s.n.* (holotipo: MPU-1469; isotipos: CIIDIR ex MPU-1469 foto!, CIIDIR ex MPU-1468 foto!, L, MPU-1468, US-80856 fragm. ex MPU-1468!).

Bouteloua prostrata hort. ex Lag., Varied. Ci. 2(4):141. 1805. *Actinochloa prostrata* (hort. ex Lag.) Roem. & Schult., Syst. Veg. 2:419. 1817. *Chondrosum prostratum* (Lag.) Sweet, Hort. Brit. 1:455. 1826. Tipo: MÉXICO: Cult. de la semilla recogida originalmente por L. Nee en México, *Lagasca s.n.*(holotipo: MA; isotipos: MA-7454, LE-TRIN 2126.3!).

Chondrosum humile P. Beauv. ex Kunth, Nov. Gen. Sp. (quarto ed.) 1:175, t. 56. 1816. *Actinochloa humilis* (P. Beauv. ex Kunth) Willd. ex Roem. & Schult., Syst. Veg. 2:417. 1817. *Eutriana humilis* (P. Beauv. ex Kunth) Trin., Gram. Unifl. Sesquifl. 239. 1824. *Atheropogon humilis* (P. Beauv. ex Kunth) Spreng., Syst. Veg. 1:293. 1825. *Bouteloua tenuis* var. *humilis* (P. Beauv. ex Kunth) Griseb., Abh. Königl. Ges. Wiss. Göttingen 24:303. 1879. *Bouteloua humilis* (P. Beauv. ex Kunth) Hieron., Bol. Acad. Nac. Ci. 4:495. 1882. Tipo: ECUADOR: "Crescit in frigidis exsiccatis, argillosis propter Llactacunga Quitensium et in monte Guadelupensi," *F. Humboldt & A. Bonpland s.n.*(holotipo: P; isotipo: US-A865683 fragm.!).

Chondrosum tenue P. Beauv. ex Kunth, Nov. Gen. Sp. (quarto ed.) 1:176, t. 57. 1816. *Actinochloa tenuis* (P. Beauv. ex Kunth) Willd. ex Roem. & Schult., Syst. Veg. 2:418. 1817. *Eutriana tenuis* (P. Beauv. ex Kunth) Trin., Gram. Unifl. Sesquifl. 240. 1824. *Bouteloua tenuis* (P. Beauv. ex Kunth) Griseb., Abh. Konigl. Ges. Wiss. Gottingen 19:259. 1874. Tipo: MÉXICO: "Novae Hispaniae prope México et San Agustin de las Cuevas," *F. Humboldt & A. Bondpland s.n.* (holotipo: P).

Bouteloua pusilla Vasey, Bull. Torrey Bot. Club 11:6. 1884. Tipo: U.S.A. New Mexico: Kingman, Jun 1881, *G.R. Vasey s.n.* (holotipo: US-81725!).

Bouteloua brachyanthera Phil., Verz. Antofagasta Pfl. 85. 1891.—Tipo: CHILE: Tarapaca, *F. Philippi s.n.* (holotipo: SGO-PHIL-267; isotipos: SGO-37549, SGO-63605, US-A865572 fragm. ex SGO-PHIL-267!).

Bouteloua rahmeri Phil., Verz. Antofagasta Pfl. 85. 1891. *Bouteloua simplex* Lag. var. *rahmeri* (Phil.) Henrard, Meded. Rijks-Herb. 40:66. 1921. Tipo: CHILE: Tarapacá, *R.A. Philippi 268* (holotipo: SGO-PHIL-268; isotipos: SGO-37548, SGO-63604; US-A865562 fragm. ex SGO-PHIL-268!).

Bouteloua simplex Lag. var. *actinochloides* Henrard, Med. Rijks-Herb 40:65. 1921. Tipo: BOLIVIA: Cochypata, 7 Nov 1857, 3000 m, *G. Mandon 908* (holotipo: L-908.86-226; isotipo: US-A865564 fragm.!).

Plantas anuales. Culmos de 7 a 23(–35) cm de alto, usualmente postrados en la mitad inferior, ascendentes distalmente a ocasionalmente erectos, glabros. Vainas glabras, mucho más cortas que los entrenudos; lígula de 0.2 a 0.4 mm de largo, membranácea, ciliada; láminas foliares de 2 a 7 cm de largo y 0.5 a 1.1 mm de ancho, aplanadas en la base, involutas distalmente, glabras o escabroso-pubecentes en la superficie adaxial, márgenes con algunos cilios arriba de la lígula. Inflorescencia una ramificación primaria espigada unilateral solitaria, persistente, de 1 a 3 cm de largo, generalmente curveada, portando 20 a 40(–60) espiguillas pectinadas. Espiguillas de 4 a 5 mm de largo, articulación por arriba de las glumas; raquilla con un mechón de pelos debajo de la flor perfecta y del primer flósculo rudimentario; glumas glabras o escabrosas en la quilla, agudas a acuminadas, primera gluma de 2 a 3 mm de largo, estrecha, casi transparente, segunda gluma de 3.5 a 5 mm de largo, más ancha; lema de 3 a 5 mm de largo, densamente pubescente sobre los nervios, estos se prolongan en aristas cortas, fuertes, aplanadas y escabrosas, el nervio central lleva la arista más larga, hasta de 2 mm de largo, que emerge entre 2 lóbulos membranáceos, de 1 mm de largo; pálea ancha, ligeramente más pequeña que la lema. Anteras de 0.8 a 1 mm largo, color amarillo claro. Flósculo rudimentario 1(–2), el primero formado por una columna de 1 mm de largo y 3 aristas fuertes escabrosas, aplanadas, de 2 a 3 mm de largo; segundo flósculo cuando presente constituido por pequeñas escamas. Cariopsis de 0.7 a 1.2 mm de largo, color pajizo, anguloso-triangular. $2n = 20, 40$. Florece de julio a diciembre.

Distribución.—Desde Estados Unidos a México en casi todos los Estados; Sudamérica: Argentina, Bolivia, Chile, Ecuador y Perú.

Hábitat.—Planicies secas, laderas rocosas, lugares perturbados y matorrales bajos; 1800 a 2150 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Piedras Negras, E de Piedras Negras, *M. Villegas 482* (IEB); Municipio de Saltillo, Saltillo, *E. Palmer 397* (US); 12 km N of the Coahuila-Zacatecas state line along highway 54 between Saltillo-Concepción del Oro, Zacatecas, 26 Aug 1981, 2000 m, *S.L. Hatch 4515, C W. Morden & J. Valdés-Reyna* (ANSM); Cañón de San Lorenzo, en la Sierra de Zapalinamé, 8 km S de Saltillo, 3.2 km E de la Universidad Autónoma Agraria Antonio Narro, 6 Oct 1979, 2080 m, *R. López s.n.* (ANSM); Rancho experimental Los Angeles, 48 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 15 Oct 1982, 1800 m, *F. Coss-V. s.n.* (ANSM); Rancho experimental Los Angeles, 48 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 3 Sep 1978, 1800 m, *J.S. Sierra s.n.* (ANSM); San Lorenzo canyon, of highway 54 (road from Saltillo to Concepción del Oro). 150 metros below first pump station, 20 Sep 1988, 2000 m, *M.E. Barkworth 5144, J. Valdés-Reyna & P.S. Hoge* (ANSM); Sierra de Zapalinamé, 5 km S de Saltillo, in San Lorenzo canyon, 25 Aug 1981, 1800 m, *S.L. Hatch 4483, C.W. Morden & J. Valdés-Reyna* (ANSM); Municipio de La Ventura, aprox. 80 km S de Saltillo, 23 Oct 1986, 1800 m, *J.A. Villarreal 3502, M.A. Carranza* (ANSM, IBUG). **Nuevo León:** Municipio de Dr. Arroyo, 21 km al N de Matehuala, *P. Hisiart 312* (MEXU); Municipio de Galeana, 73 mi S de Saltillo *F.W. Gould 10112* (US); 6.5 mi S of border of Coahuila and Nuevo León on Hwy 57 towards Matehuala, 16 Oct 1995, 1920 m, *P.M. Peterson 13281, M.B. Knowles* (US); Municipio de Zaragoza, 4 km W of Tepehuanes on road towards Zaragoza, 21 Sep 2001, 1930 m, *P.M. Peterson 15866, J. Valdés-Reyna* (US). **Tamaulipas:** Municipio de Bustamante, Joya de Herrera, 20 Oct 1982, 2150 m, *C.R. López 45* (MEXU).

22. Bouteloua tamaulipensis G.J. Pierce ex D. Pacheco & Columbus, sp. nov. (**Figs. 28–31**). *Cathestecum tamaulipense* Beetle, Las Gramíneas de México 2:177. 1987, *nom. nud.* Tipo: MÉXICO. Tamaulipas: Municipio de Jiménez: on mesa ca. 7.5 road mi NNE of Santander Jiménez along Hwy 101, 24°18'57"N, 98°26'16"W, elev. ca. 200 m, 22 Sep 1996, *J.T. Columbus 2885* (holotipo: RSA!; isotipos: ANSM!, MEXU!, MO!, US!).

Boutelouae erectae (Vasey & Hack.) Columbus affinis, sed differt statura minore, insigniter internodiis stolonis ramis inflorescentiae et antheris brevioribus.

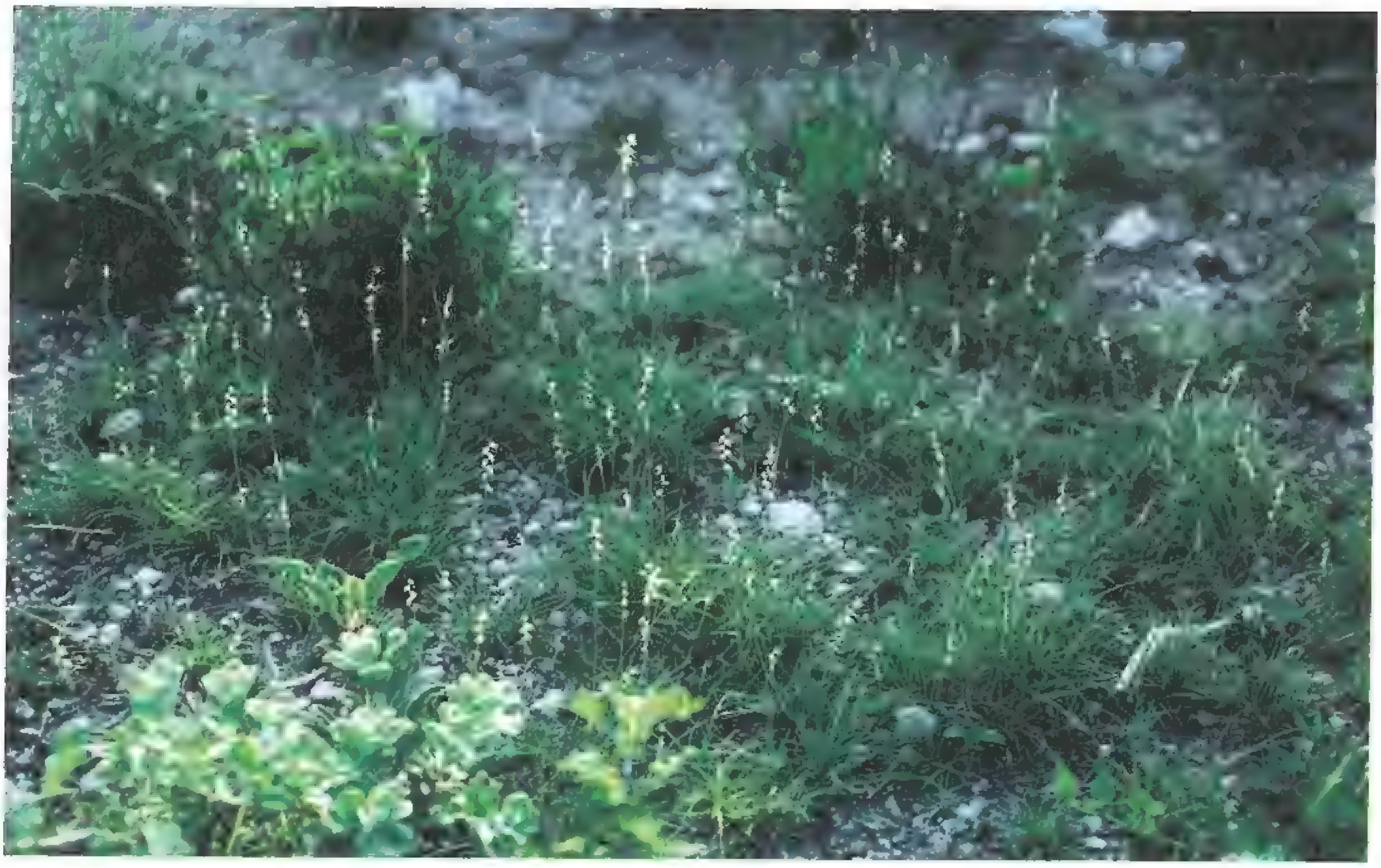
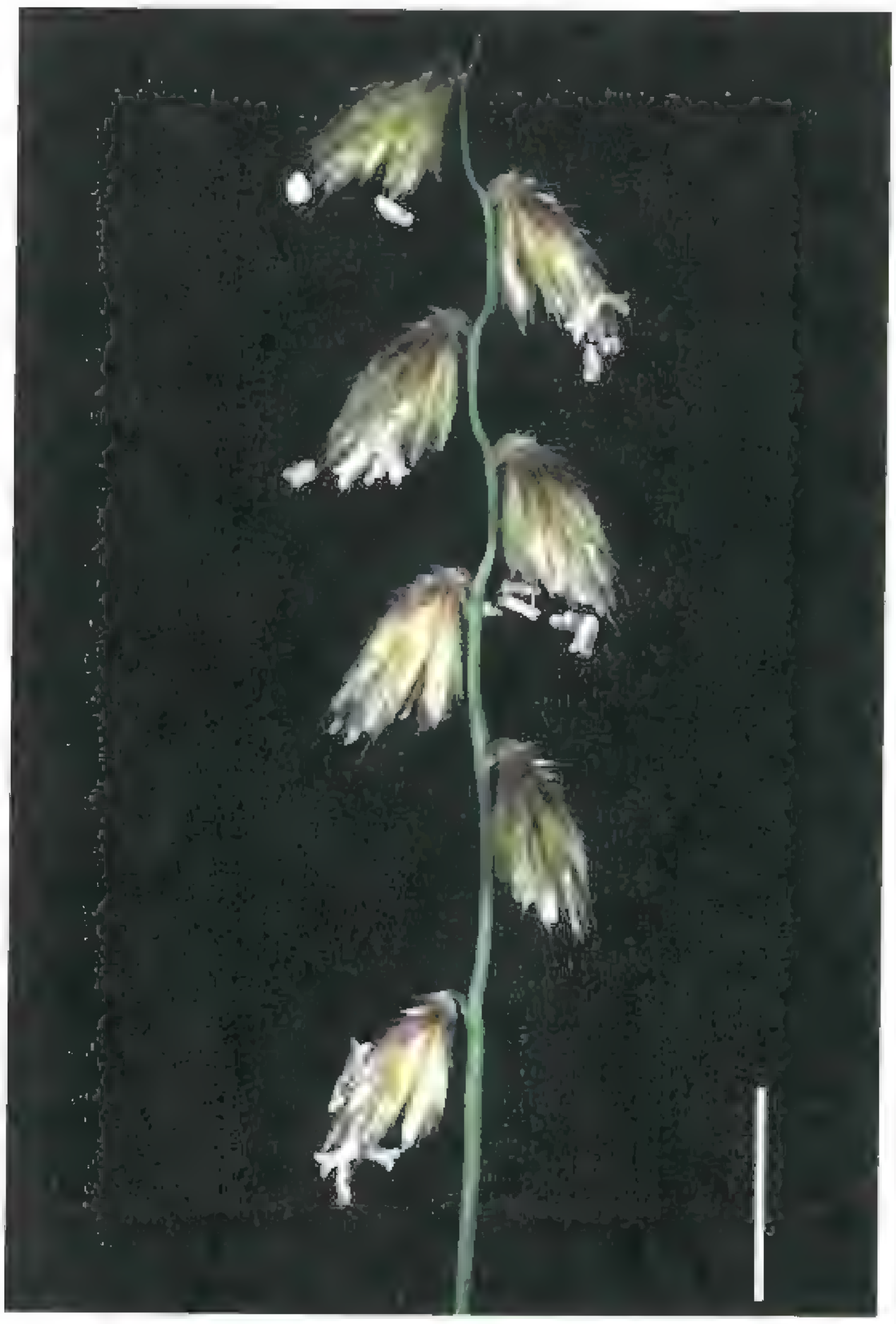


Fig. 28. *Bouteloua tamaulipensis* en la localidad tipo (*J.T. Columbus 2885*).



Plantas perennes, cespitosas, estoloníferas, polígamo-monoicas. Entrenudos de los estolones de 4 a 14 cm de largo, arqueados ligeramente, de color verde a púrpura, nudos densamente pilosos. Culmos de 2 a 22 cm de alto, rectos y erectos o geniculados y ascendentes, con 0 a 2 nudos vegetativos visibles, a menudo con una rama en el nudo superior, nudos usualmente pubescentes. Hojas principalmente basales; vainas con un margen escarioso, ciliadas, los pelos más largos en el ápice o restringidos a él (a los lados de la lígula), vaina de las hojas jóvenes sobre estolones abaxialmente pilosos, la mayoría cerca de la base; lígula compuesta de pelos de cerca de 0.2 mm de largo, láminas de hasta 10 cm de largo y 1 mm de ancho, aplanadas o involutas cuando secas, por lo general glabras abaxialmente, adaxialmente con pelos largos espaciados a lo largo de la nervadura central, margen escabroso. Inflorescencia incluida dentro del follaje o alta y bien exserta, compuesta de 3 a 8 ramas primarias

Fig. 29. Inflorescencia de *Bouteloua tamaulipensis* (*J.T. Columbus 2885*). Barra de escala = 0.5 cm.

dísticas, con una inflorescencia lateral a menudo originándose desde el nudo superior; raquis de 0.5 a 3 cm de largo, aplanado, ligeramente sinuoso, glabro, el ápice cortamente bífido, entrenudos de 0.2 a 0.6 mm de largo; ramas de 4 (en inflorescencias cortas) a 6 (en inflorescencias largas) mm de largo, péndulas, cada una conteniendo tres espiguillas apretadas, con las primeras glumas afrontadas, púrpuras o con tintes purpúreos (glumas, lemas y/o aristas), el eje cerca de 1 mm de largo, no prolongado mas allá de la espiguilla terminal, desarticulándose cerca de la parte media en la madurez, puberulento debajo del punto de abscisión, densamente piloso por arriba de él, las espiguillas caen en grupo. Espiguillas de una rama dimórficas: espiguilla terminal (central) más larga (de 3.7 a 5.2 mm de largo), primera gluma más corta, flósculos 3 ó 4, primer flósculo hermafrodita (inflorescencias altas) o pistilado (inflorescencias cortas; estaminodios usualmente presentes), los flósculos restantes estaminados o neutros, espiguilla proximal (lateral) más corta (de 1.5 a 3.8 mm de largo), primera gluma más larga, flósculos 2 ó 3, neutros (inflorescencias cortas) o los primeros uno a dos flósculos estaminados (inflorescencias altas). Glumas variables en tamaño, forma e indumento; primera gluma sin nervaduras, glabra (raramente pubescente en las espiguillas laterales), algunas veces 1- ó 2-lobadas, primera gluma de la espiguilla terminal de 0.4 a 0.6 mm de largo y típicamente flabelada, truncada y sin arista, primera gluma de las espiguillas laterales de 0.6 a 1.5 mm de largo, típicamente lanceolada y aristada en el ápice; segunda gluma de 1.3 a 3.5 mm de largo, por lo general ampliamente lanceolada, 1-nervada, pilosa (densamente pilosa en mitad inferior a lo largo de la nervadura central), ápice terminando en una pequeña arista o acuminado, algunas veces ligeramente 2-lobado. Flósculo superior algunas veces rudimentario, de menos de 1.5 mm de largo y sin arista. Lema 3-nervada, 2- ó 4-lobada, usualmente con los ápices obtusos o agudos, 3-aristada desde las nervaduras, la arista central originándose entre dos lobos, las aristas laterales iguales a o ligeramente más largas que la arista central; lema del primer flósculo de 1.6 (espiguillas laterales) a 3.5 (espiguilla terminal) mm de largo, 2-lobada cerca de 1/3 del largo del cuerpo de la lema (algunas veces dos lóbulos laterales también presentes), por lo general esparcidamente pilosa a través de la parte central del dorso por debajo de los lobos, los pelos algunas veces limitados a cerca del margen, aristas de 0.6 a 1.3 mm de largo, iguales a o excediendo el cuerpo de la lema por 0.3 mm o menos, escabrosas; lema de los flósculos superiores (excluyendo la flor rudimentaria, si está presente) de 1.1 (espiguillas laterales) a 3.7 (espiguilla terminal) mm de largo, 4-lobada cerca de 2/3 o más del largo del cuerpo de la lema, el cuerpo glabro o con algunos pelos cerca de la base de los lobos laterales, aristas de 0.3 a 3.0 mm de largo, usualmente excediendo el cuerpo de la lema por 0.1 a 1.3 mm, pilosas sobre la mitad inferior y escabrosas en la mitad superior o completamente escabrosas. Pálea de 0.7 a 3.5 mm de largo, más larga en la primera flor de la espiguilla terminal, en el primer flósculo casi igual en longitud a (y algunas veces ligeramente excediendo) la lema, progresivamente más corta en los flósculos superiores en relación a la lema, usualmente con dos o más lóbulos en el ápice, por lo general esparcidamente pilosa sobre los 2/3 superiores a lo largo de las dos nervaduras, las nervaduras usualmente extendiéndose en aristas cortas de hasta 0.6 mm de largo. Anteras usualmente de menos de 1.5 mm de largo, con tintes purpúreos; estigmas púrpura obscuro. Cariopsis no observada. $2n = 20$ (Pierce 1979; Pacheco 2002).

Comentarios.—*Bouteloua tamaulipensis* está más cercanamente relacionada a ejemplares robustos de *B. erecta*, taxon que se distribuye en el Desierto Chihuahuense hacia el noroeste de la distribución de *B. tamaulipensis* (Pierce 1979; Pacheco 2002; J.T. Columbus inéd.).

Distribución.—Endémica de Tamaulipas, México. Conocida sólo de un área limitada al noreste de Santander Jiménez.

Hábitat.—En claros de matorral xerófilo con árboles bajos y en áreas de perturbadas que son resultado de la remoción de la vegetación leñosa; suelo rocoso calcáreo; cerca de 200 m de altitud.

Ejemplares adicionales examinados. **MÉXICO. Tamaulipas:** Municipio de Jiménez, 10 km from Santander Jimenez on the road to San Fernando, 19 Oct 1956, *F. Martinez Martinez & G. Borja Luyando F-2451* (MICH, TEX, US); 11 mi N of Santander Jimenez toward San Fernando, 800 ft, 25 Nov 1959, *J. Graham & M.C. Johnston 4828* (MICH, TEX); 11 mi N of Jimenez on the San Fernando highway, 900 ft, 9 Dec 1959, *M.C. Johnston 4896* (MICH, TEX); 7 km from Santander Jimenez toward San Fernando, 23 Oct 1975, *G.J. Pierce 2339* (RM); 11 km from Santander Jimenez toward San Fernando, roadside, 23 Oct 1975, *G.J. Pierce 2340* (RM); 18 km from Santander Jimenez toward

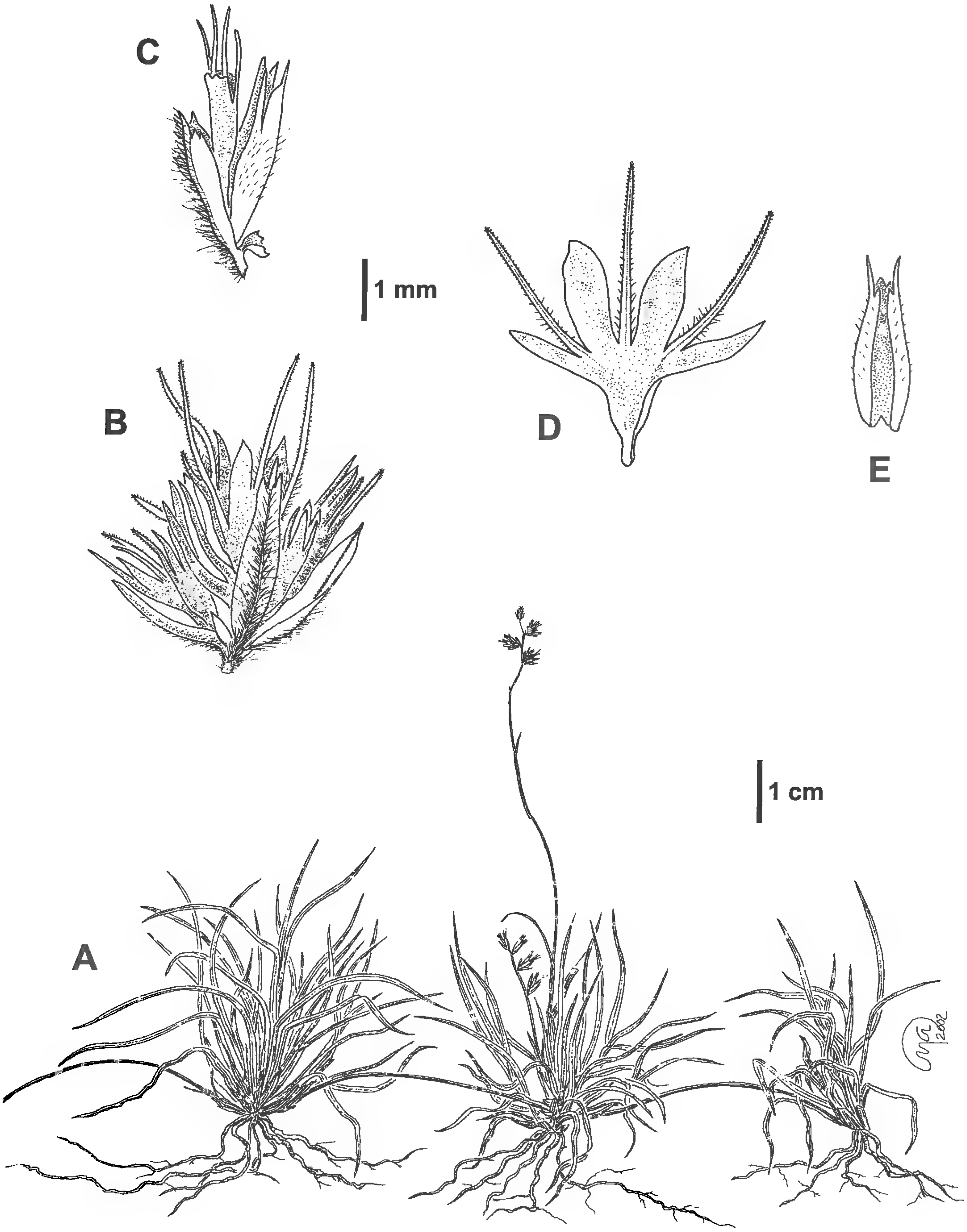


Fig. 30. *Bouteloua tamaulipensis* (*D. Pacheco & J.O. Zambrano 2552*). **A.** Hábito. **B.** Rama de la inflorescencia. **C.** Espiguilla terminal (central) de la rama de la inflorescencia. **D.** Lema del segundo flósculo. **E.** Pálea del segundo flósculo. La barra de escala inferior aplica a A; la barra de escala superior aplica a B–E.

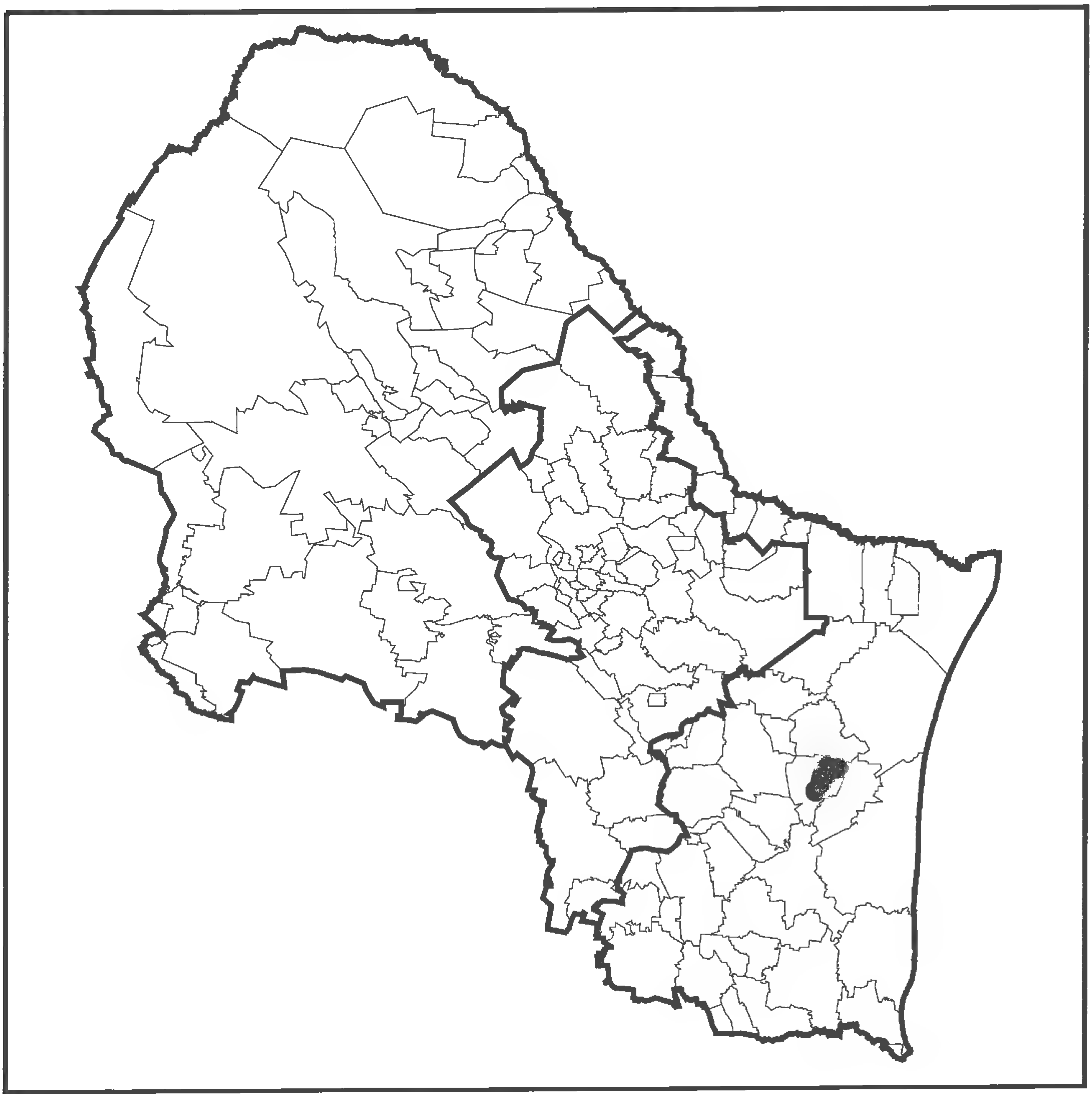


Fig. 31. Distribución de *Bouteloua tamaulipensis* en el noreste de México.

San Fernando, 23 Oct 1975, *G.J. Pierce 2341* (RM); 20 km from Santander Jimenez toward San Fernando, roadside, 23 Oct 1975, *G.J. Pierce 2343* (RM); El Encinal, 2 Sep 1981, *Villegas 468* (MEXU); El Encinal, 23 Nov 1981, *Brito 056* (MEXU); 5 mi NNE of Santander Jiménez just off Hwy 101 along road E to La Misión, 24°17'12"N, 98°27'20"W, ca. 200 m, 2 Nov 1992, *J.T. Columbus 2426* (ANSM, MEXU, MO, RSA, UC, US); Ejido Sor Juana Inés de la Cruz, 190 m, 28 Sep 1993, *Galván 319* (MEXU); a 8 km por la carretera 101 al N del poblado de Santander Jiménez, *M.H. Cervera 403* (MEXU); carretera Santander Jiménez–San Fernando, 15 km al N de Santander Jiménez, aprox. 200 m de la entrada al Ejido El Encinal, 24°23.867'N, 98°23.300'O, 150 m, 12 Sep 1999, *D. Pacheco & J.O. Zambrano 2552* (HERZU, IZTA, MEXU); Santander Jiménez, Aldama cenotes, *J. Valdés-Reyna 2402* (ANSM).

23. Bouteloua trifida Thurb., Proc. Amer. Acad. Arts 18:177. 1883. (**Fig. 32**). *Chondrosum trifidum* (Thurb.) Clayton, Kew Bull. 37:418. 1982. Tipo: MÉXICO. Coahuila: Monclova, Aug 1880, *E. Palmer 1355* (holotipo: GH; isotipos: NY, US-A865565!, US-821003!, US-883967,! US-2474825 foto!).

Bouteloua burkii Scribn. ex S. Watson, Proc. Amer. Acad. Arts 18:179. 1883. *Bouteloua trifida* Thurb. var. *burkii* (Scribn. ex S. Watson) Vasey ex L.H. Dewey, Contr. U.S. Natl. Herb. 2(3):532. 1894. Tipo: U.S.A. Texas: west Texas, upper Concho, sandy plains, Apr

1882, *J. Reverchon s.n.*-3440 Curtiss's distribution of North American plants (lectotipo, designado aquí: US-883346!; isolectotipo: US-820915!).

Chondrosum trinii E. Fourn., Mexic. Pl. 2:136. 1886. *Bouteloua trinii* (E. Fourn.) Griffiths, Contr. U.S. Natl. Herb. 14(3):387, f. 41, 42, pl. 74. 1912. Tipo: U.S.A. Texas. Webb Co.: Laredo, *Berlandier 1427* (holotipo: P; isotipos: K, US-A865684!, US-204622!, US-1084518!, US-883356!).

Chondrosum virletii E. Fourn., Mexic. Pl. 2:136. 1886. Tipo: México. San Luis Potosí: Aug 1857, *Virlet 1373* (holotipo: P; isotipo: US-A865685 fragm.!).

Plantas perennes, amacolladas, con base rizomatosa. Culmos de 10 a 30(–40) cm de alto, delgados, finamente escabrosos, no-ramificados excepto en la base rizomatosa; entrenudos glabros. Vainas mucho más cortas que los entrenudos, finamente escabrosas; lígula de 0.2 a 0.6 mm de largo, un anillo de cilios; láminas foliares de 2 a 8 cm de largo y 0.5 a 1.2 mm de ancho, principalmente basales, aplanadas, conduplicadas o involutas, cuando involutas con el ápice puntiagudo, escabroso-puberulentas principalmente hacia la base y en la superficie adaxial, con algunos pelos dispersos sobre el margen, de 1.5 mm de largo. Inflorescencia de 1 a 5(–8) cm de largo, con 3 a 7 ramificaciones primarias espigadas persistentes, espaciadas 1.2 a 1.8 (2) cm de distancia, sobre un raquis recto, nunca en zigzag; ramificaciones de 1 a 3(–4) cm de largo y 3 a 5 mm de ancho, portando 8 a 24(–32) espiguillas, color verde-amarillento o con tintes purpúreos. Espiguillas de 5.8 a 9 mm de largo, articulación por arriba de las glumas; glumas desiguales, muy delgadas, casi transparentes, agudas, acuminadas o mucronadas, con el ápice bífido, primera gluma 3 a 4 mm de largo, segunda gluma de 5 a 5.5 mm de largo, lisa, glabra, a menudo color púrpura-rojizo; lema de la flor perfecta de 1.2 a 2.2 mm de largo, glabra, con 3 aristas de 4.5 a 5(–6) mm de largo, aplanadas, redondeadas y pubescentes hacia la base, escabrosas hacia el ápice; pálea de 1.2 a 2.2 mm de largo, con el ápice obtuso. Anteras de 0.5 a 0.6 mm largo, color blanco amarillentas. Flósculo rudimentario 1, reuducido a una columna corta, de 1.5 a 2.5 mm de largo y 3 aristas de 3.5 a 6 mm largo. Cariopsis de 0.7 a 1 mm de largo, color amarillo, oblongo-elipsoide. $2n = 20$. Florece de mayo a diciembre.

Distribución.—Centro y S de Estados Unidos al N de México.

Hábitat.—Se la encuentra sobre planicies secas, laderas con pastizal y bosque de encino-pino, sobre diversos tipos de material; 60 a 2000 m.

Ejemplares examinados. **MÉXICO. Coahuila:** 2 mi NW de la Frontera, *I.M. Johnston 7171* (US); Municipio de Allende, 13 mi SO of Ciudad Allende toward Sabinas, 7 Oct 1959, 488 m, *M.C. Johnston 4177, J. Graham* (MEXU); Municipio de Arteaga, Arroyo Canoas, 28 Jul 1993, 1600 m, *F. Alcaláá 22* (MEXU); Municipio de Castaños, Rancho de Santa Teresa, al S de Castaños, *1936* (MEXU); Rancho de Santa Teresa, al S de Castaños, 19 Jun 1936, 910 m, *L.F. Wynd 205, C.H. Muller* (ANSM); Municipio de Cuatrociénegas, 5 km al E de Cuatrociénegas, 24 May 1977, 740 m, *J. Valdés-Reyna-Reyna 967* (ANSM); Entrada al Casco del Rancho Potrero de Menchaca, 30 Aug 1980, 1600 m, *R. Vásquez 58, L.E. Rodríguez* (ANSM); Sierra de la Madera, Cañón Charreteras, rancho Charreteras, 15 Sep 1993, 1750 m, *J.A. Villarreal 7351, M.A. Carranza & R. Rodríguez* (ANSM); Municipio de Escobedo, 54.8 km N of Monclava on Mex 57 at jct of road to Progreso, 15 Oct 1989, 480 m, *P.M. Peterson 8379, J. Valdés-Reyna-Reyna* (US); Municipio de General Cepeda, Ejido La Rosa, carretera 40 Saltillo-Torreón, aprox. 20 km NE de General Cepeda, 5 Jul 1986, 1230 m, *S. Vásquez 98, A. García* (ANSM); Terrenos desérticos entre Hacienda Rosa y Hacienda Lechuguilla Hipolito, *1936* (MEXU); Municipio de Hidalgo, Rancho Santa Barbara, 28 Nov 1989, 190 m, *J.A. García* (UAT); Municipio de Monclova, Puerto Santa Ana, 27 Jul 1973, 1000 m, *J.S. Marroquín 2458* (ANSM); 22 mi N de Monclova, *J.R. Reeder & C.G. Reeder 5010* (US); 43 mi N of Monclova, *F.W. Gould 6410* (ANSM); km 25 carr. Saltillo-Monclova, *M. Tórres 1593* (ANSM); 2 km al N de Cañada Blanca, km 17 carr. 57 Saltillo-Monclova, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1480, 1483* (CIIDIR, HUAA); Municipio de Múzquiz, 7.2 mi SE of Jaboncillos on road towards Cuesta de malena and Melchor Muzquiz, 01 Sep 2006, 1010 m, *P.M. Peterson 19847, S. Lara-Contreras* (US); Rancho "Las Pilas," Múzquis, *E. García s.n.* (IBUG); Saltillo, *L.M. Villarreal 16853* (IBUG); 8 km al SE de Palau, camino a Barroteras, Múzquiz, J. *Valdés-Reyna VR-939* (ASNM, IEB); Municipio de Nava, área de encinos, aprox. 10 km O de la cabecera municipal rumbo a Nava, 13 Jul 1988, 300 m, *A. Rodríguez 1012, 1032, J. Valdés-Reyna & M. Solís* (ANSM); Level plains of the Río Grande Valley, just N of Río Escondido, 18 kmSSO of Piedras Negras on México No. 57, 12 Sep 1978, 300 m, *H.H. Iltis 10, A. Lasseigne* (COCA, MEXU, IBUG); Valle de Río grande al N del Río Escondido, 18 km SSW de Piedras Negras, *H.H. Iltis 15222 A. Lasseigne* (UAG); Municipio de Ocampo, Base of hills in palma-belt, near mouth of Cañón de la Cruz, about 20 km S of Ocampo, 16 Sep 1941, *I.M. Johnston 9179* (MEXU); S of Laguna de La Leche, 30 Aug 1941, *I.M. Johnston 8619* (MEXU); Sierra de la Madera, Rancho Laguna de la Leche, aprox. 62 km de Ocampo rumbo a Sierra Mojada, 2 Oct 1990, 1000 m, *M.A. Carranza 621, F J. Carranza* (ANSM); Municipio de Ramos Arizpe, 63 mi S of Monclova on highway 57, 9 Aug 1959, 396 m, *T.R. Soderstrom 361* (MEXU, US); El Cedral, Sierra de la Paila, 16 Oct 1986, 1300 m, *J.A. Villarreal 3628, M.A. Carranza & R. Rodríguez* (ANSM); 2 Nov 1988, *J.A. Villarreal 4812, M.A. Carranza* (ANSM, IEB); Estación La Sauceda, 20 Sep 1964, 1030 m, *J.S. Marroquín* (ANSM); Estación Paredón, 5 Sep 1987, 1400 m, *A.*

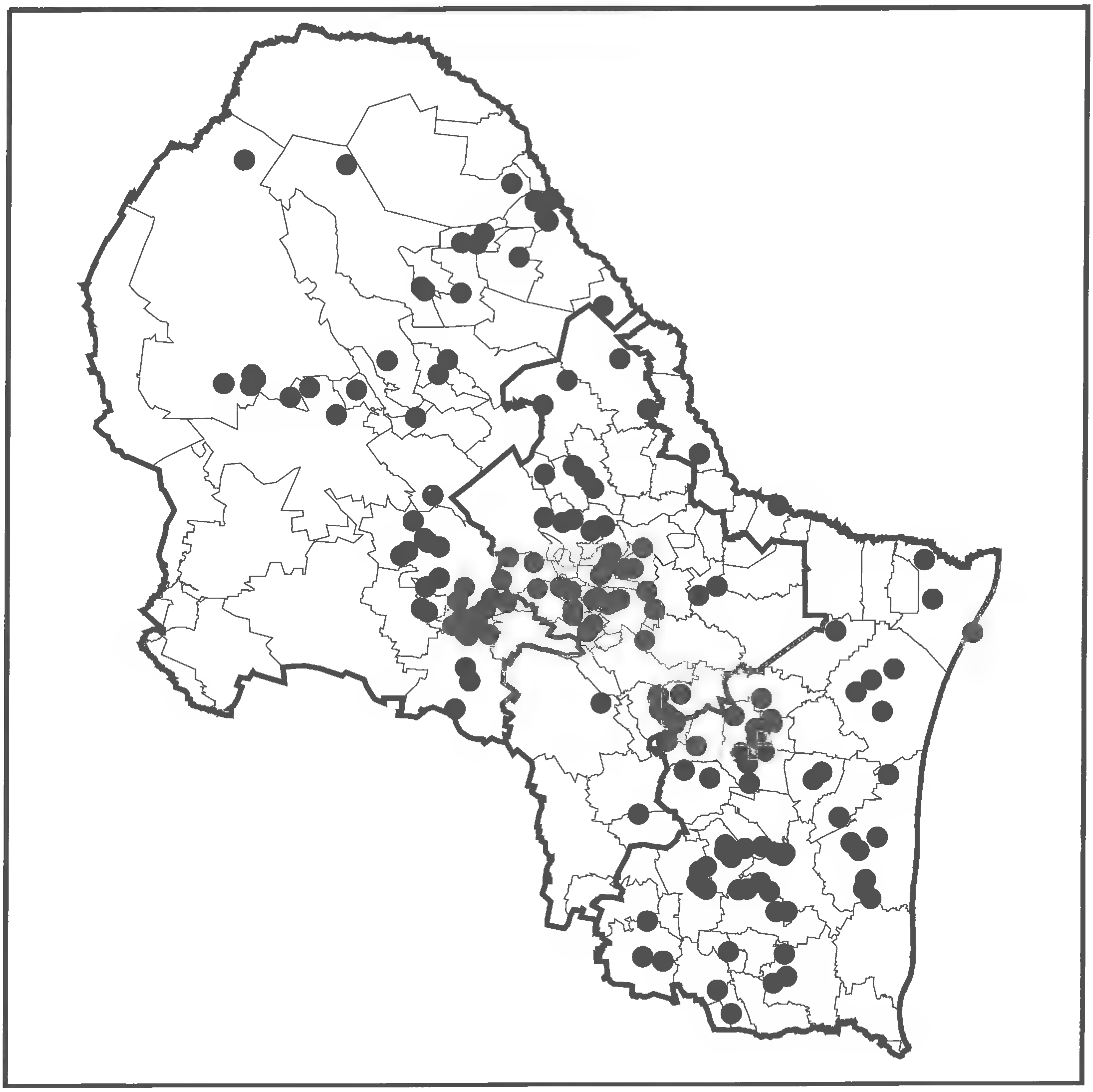


Fig. 32. Distribución de *Bouteloua trifida* en el noreste de México.

Rodríguez 905, M.A. Carranza & J.M. Sosa (ANSM); Ramos Arizpe, 21 Sep 1975, 1650 m, *R. Palomo s.n.* (ANSM); San Gregorio, carretera Monterrey-Saltillo, 16 Sep 1983, 1350 m, *J.A. Villarreal 2191* (ANSM, CIIDIR); San Juan de las Bonitas, 19 Jul 1993, 1450 m, *E. Pérez 25* (MEXU); Sierra de la Paila, Ejido el Cedral por el camino El Carmen, 26 Aug 1992, 1300 m, *J. Valdés-Reyna 2180* (ANSM); km10 camino Saltillo-Gral. Cepeda, W de Saltillo, *J. Espinoza 135* (ANSM); Ejido La Rosa, carr. 40, Saltillo-Torreón, aprox. 20 km al NE de Gral. Cepeda, *S. Vázquez & A. García 98* (ANSM); km 30, carr. 40 Saltillo-Monterrey, Ramos Arizpe, *Y. Herrera Arrieta & A. Cortés 1455* (CIIDIR, HUAA); Cerro del Pueblo, al W de la cd. de Saltillo, 16 Jul 1983, 1400 m, *J. Valdés-Reyna VR-1847, M.A. Carranza* (ANSM, CIIDIR); 11 kmW of Saltillo, *G. Mick & K. Roe 17* (MEXU); km13 al W de Saltillo, *E. Hernández & V. Mathus 2022* (CHAPA); 12 km O de Saltillo, carretera 40 camino a La estación de Microondas Vega, 9 Jul 1983, 2000 m, *J. Valdés-Reyna 1530, L.E. Rodríguez* (ANSM); Municipio de Sabinas, 85.4 km NW of Muzquiz on Hwy 53 towards Boquilla del Carmen, vía La Rosita, 12 Sep 1991, 810 m, *P.M. Peterson 10570, C.R. Annable* (US); Ejido Agujita, Mar 1977, 350 m, *J.F. Sifuentes s.n.* (ANSM); Municipio de Saltillo, 28.2 mi S de Saltillo, carretera 54 a Concepción del Oro, Zac., 24 Sep 1990, 1850 m, *P.M. Peterson 10014, C.R. Annable & J. Valdés-Reyna* (ANSM, US); Rancho experimental Los Angeles, 48 kmS de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 30 Jul 1979, 1800 m, *J.S. Marroquín* (ANSM); Rancho Los Angeles, 48 km al S de Saltillo, *P.E. García s.n.* (ANSM); N of Saltillo on Mex 57, N of Lázaro Pass, and 0.5 km S of La Muralla Restaurant, 13 Oct 1989, 1150 m, *P.M. Peterson 8353 & J. Valdés-Reyna* (US). **Nuevo León:** Municipio de Anáhuac, 34 mi S of Nuevo Laredo, 14 Nov

1958, *R.C. Rollins 5812, R.M. Tryon* (MEXU); Municipio de Apodaca, Carretera Monterrey-Miguel Alemán, 28 May 1972, 430 m, *R. Almeida 2676* (UAT); Municipio de Bustamante, En el Cañón de Bustamante, 18 Jun 1993, 600 m, *P. Jauregui 67* (MEXU); Municipio de Cadereyta Jiménez, Carretera a Reynosa, 2 km O de la Refinería Cadereyta, 26 Sep 1979, 330 m, *J.A. Villarreal* (ANSM); En los alrededores del poblado de Cadereyta, 22 Mar 1993, *N. Bazaldua 18* (MEXU); Rancho San Angel, km 7 camino a San Mateo, carretera Villa Juárez-Cadereyta, 25 Mar 1993, *M.M. Castillo 47* (MEXU); Municipio de Cerralvo, 8.5 mi E of highway 54 going to Rancho el 30, Sierra de Picachos near Cerralvo, 16 Aug 1983, 700 m, *J. Kessler 4859* (ANSM); Municipio de China, 1 km N del rancho La Osca, 23 Mar 1972, 160 m, *J. Valdés-Reyna s.n.* (ANSM); Presa La Ceja, carretera 40, 13 Sep 1992, 100 m, *J.A. Villarreal 6843, M. Vásquez, D.E. Lozano & J. Valdés-Reyna* (ANSM); Municipio de Doctor González, 1 km al SE del poblado de Doctor González, rumbo a los fresnos a la orilla del río Doctor González, 19 May 1993, 360 m, *N. Bazaldua 68* (MEXU); Carretera Doctor Gonzalez-Cerralvo, km 52, 19 May 1993, 400 m, *N. Bazaldua 81* (MEXU); Municipio de Galeana, Cerca de Galeana, Oct 1980, 1650 m, *J.A. Ochoa 1102* (MEXU); Municipio de García, 3 km from El Milagro and 10 km from Icamole on winding road between, 5 Jul 1976, 720 m, *M.C. Johnston 11615*[a], *T.L. Wendt & F. Chiang* (MEXU); Límites de Coahuila-Nuevo León por la carretera a Saltillo, Nov 1980, 1000 m, *J.A. Ochoa 1213* (MEXU); Municipio de General Zaragoza, 9 km S of Aramberri on road towards Zaragoza, 20 Sep 2001, 1400 m, *P.M. Peterson 15836, J. Valdés-Reyna* (US); Municipio de Higueras, Falda de la Loma Higueras frente a las instalaciones de la Unión Ganadera de Higueras, 1 Jul 1993, *P. Jauregui 84* (MEXU); Municipio de Juárez, Carretera Villa de Juárez-San Mateo, km 5, 18 May 1993, *M.M. Castillo 69, 76* (MEXU); San Roque, 11 Sep 1976, 500 m, *I.A. Jiménez s.n.* (ANSM); Municipio de Lampazos de Naranjo, Lomas El Tanque, 16 May 1982, 380 m, *O.L. Briones 949* (ANSM); Rancho Santa Elena, carretera Lampazos-Horcones, 5 km de terracería al N, 18 Oct 1992, *J. Garza 9* (MEXU); Lampazos, Dic 1980, *J.A. Ochoa 1233* (MEXU); Municipio de Linares, 11 mi S of Linares toward Villagrán, 12 Nov 1959, 457 m, *M.C. Johnston 4653* (MEXU); Ejido el Porvenir, 19 May 1980, 200 m, *J.J. Ortíz s.n.* (ANSM); Localizado en el rancho El Nogalar, ubicado en la carretera Linares-San Roberto, km12, 2 Jun 1993, 440 m, *M.M. Castillo 85* (MEXU); Rancho La Escondida, km 8, 19 Jun 1992, *P. Jauregui 3* (MEXU); Rancho San José de los Hoyos, km 15 carretera Linares-Iturbide, 1 Abr 1993, *J. Garza 22* (MEXU); Municipio de Los Ramones, 2 km S del entronque a la carretera Monterrey-Reynosa, 26 Nov 1980, 210 m, *J.A. Villarreal 1019* (ANSM); Municipio de Marín, Facultad de Agronomía, Universidad Autónoma de Nuevo León, km 17, Marín, 14 Jun 1992, *M.M. Castillo 5* (MEXU); Facultad de Agronomía, Universidad Autónoma de Nuevo León, km 17, Marín, 15 Nov 1992, *P. Jauregui 31* (MEXU); Municipio de Mina, Predio 'El Venado,' 12 Jun 1976, 600 m, *G. Villegas 2, A. Bolaños* (MEXU); Municipio de Monterrey, Sierra Madre mountains, 3 Aug 1933, *C.H. Mueller 421, M.T. Mueller* (MEXU); Valley of Monterrey, 13 Jul 1889, *C.G. Pringle 2671* (MEXU); Obispado, *J. Roybal 63* (US); Carr. Villa de Garcia a Grutas, W de Monterrey, *T. Tateoka 1086* (US); *I. Cabral 123* (ANSM); Aprox. 30 km de Monterrey a Laredo, 1 km al E de la carr., *J. Ortíz s.n.* (CHAPA); Carretera a Trinidad China, Dic 1980, *J.A. Ochoa 1226, 1227* (MEXU); Dry hills and mesas, Monterrey, 5 Jul 1988, *C.G. Pringle 1974* (MEXU, US); Aprox. 30 km de Monterrey a Laredo, 1 km al E de la carr., *J. Cantú s.n.* (CHAPA); Municipio de Pesquería, Carretera Monterrey-Pesqueria 2 km antes del poblado, 19 Nov 1986, 350 m, *P.A. García 1847* (MEXU); Municipio de Sabinas Hidalgo, 5 mi S of Sabinas Hidalgo; along road to Monterrey, 16 Jul 1955, *H.M. Chute 272* (MEXU); Fracción del Río Sabinas, junto al centro recreativo Ojo de Agua de Sabinas Hidalgo, 24 Mar 1993, *N. Bazaldua 46* (MEXU); Municipio de Salinas Victoria, Planos Rancho La Barrosa, May 1981, 550 m, *J.A. Ochoa 1170* (MEXU); Rancho La Soledad, May 1981, 500 m, *J.A. Ochoa 1109* (MEXU); Sierra de Mamulique, 29 Ene 1993, *M.M. Castillo 40* (MEXU); Municipio de Santa Catarina, 17 mi E of Monterrey, 1 Jul 1947, *F.A. Barkley 7161, G.L. Webster & C.M. Rowell Jr.* (MEXU); Municipio de Santiago, San Juan Bautista, 28 Nov 1982, 1700 m, *I. Cabral 123* (ANSM); Villa de Santiago, Dic 1980, 550 m, *J.A. Ochoa 1152* (MEXU); Municipio de Villaldama, Mountains E of state highway 34, 1.4 km (0.9 mi) N of jct to Bustamante, dirt road 15.7 km (9.8 mi) E of highway, 15 Mar 1983, 420 m, *C.P. Cowan 3823, K.C. Nixon* (ANSM). **Tamaulipas:** Municipio de Abasolo, 2 km antes de llegar al ejido Morelos, 24 Ene1985, 40 m, *R. Díaz 269* (UAT); Ejido La Esperanza, 23 Sep 1982, 110 m, *J.F. Iribe 147* (MEXU); La Cascada, 16 Oct 1982, *R.A. Carranco 282* (MEXU); Municipio de Antiguo Morelos, Ejido El Sauz, 18 Aug 1981, 160 m, *R.A. Carranco 34* (COCA, IEB); Municipio de Burgos, Rancho Tanques, Aug 1980, 250 m, *J.F. Iribe 23* (MEXU); Municipio de Bustamante, Ejido Calabacillas, 19 Mar 1987, 1200 m, *M. Cisneros 116* (MEXU); Municipio de Camargo, Carretera la Rivereña, a orillas del camino adyacente al rea agrícola, 24 Oct 1980, *J.F. Iribe s.n.* (MEXU); Municipio de Casas, 2 km antes de Villa de Casas, 4 Jun 1987, 310 m, *C.R. López 143, 144* (MEXU); 35 km from Victoria on the road to Casas and Soto la Marina, 3 Oct 1956, 280 m, *F. Martínez 2300, 2349, G. Borja* (MEXU); Camino a la Lajita,18 Mar 1994, *J.G. Galván 400* (MEXU); Rumbo Ejido 1° de Abril, 28 Jul 1983, 260 m, *J.L. Ramos 147* (MEXU); Municipio de Gomez Farías, La Poza Azul, nacimiento del río Frío. Reserva de la Biosfera El Cielo, 25 Aug 1993, 300 m, *J.L. Mora 428, A. Mora & L. Corral* (UAT); Municipio de González, 19 km from Mante on the Tampico highway, 18 Sep 1956, *F. Martínez 1710, G. Borja* (MEXU); 24.5 km al E de Xicotencatl, 11 Jun 1992, 170 m, *J.G. Galván 269* (MEXU); Ejido Gustavo A. Madero, 14 May 1981, 80 m, *J.A. Barrientos 19* (MEXU); Ejido Josefa Ortíz de Domínguez, Sep 1983, 380 m, *P. Moya 35, 152* (MEXU); km 56 González-Llera, 14 Oct 1987, 250 m, *J.G. Galván 215* (MEXU); Orilla Magiscatzin, 3 Mar 1987, 180 m, *J.G. Galván 202* (MEXU); Rancho La Peñita, 21 Sep 1982, 90 m, *J.L. Ramos 78* (MEXU); Municipio de Gómez, Ejido Acatlán, 5 Oct 1983, 180 m, *P. Moya 40* (MEXU); km 26, Rancho el Soldado, 28 Sep 1993, 150 m, *O.M. Galván 606* (MEXU); Rancho El Melón, 8 Sep 1983, 150 m, *M.H. Cervera 187* (MEXU); Rancho El Melón, 5 Sep 1987, 150 m, *J.G. Galván 212* (MEXU); Municipio de Hidalgo, Ejido El Progreso, 5 Nov 1985, *J.F. Iribe 257* (MEXU); Estación La Cruz, Hidalgo, *D. Villegas 011* (IBUG); Municipio de Jaumave, Ejido José de Salamanca, 29 Oct 1982, 630 m, *P. Moya 9* (MEXU); Ejido José Maria Morelos, 7 Oct 1982, 690 m, *J.F. Iribe 143* (MEXU); Ejido San Antonio km132 carretera Victoria-Jaumave, 25 Abr 1985, 1280 m, *M. Martínez & Díaz de Salas 285* (MEXU, UAT); Ejido San Francisco de Zorrilla, 11 Jun 1979, 700 m, *A. Bolaños 6, 499* (MEXU); Municipio de Jiménez, 2 km del Rancho El Rivereño, 4 Dic 1986, 210 m, *M.H. Cervera 400* (MEXU); 8 km al N del Poblado Santander Jiménez, 5 Dic 1986, 200 m, *M. Cisneros 111* (MEXU); Adelante de la parida, *G. Villegas 999* (IEB); Municipio de Llera, Ejido 1ø de Abril, 27 May 1982, 230 m, *R.A. Carranco 121, 122* (COCA, IEB); Ejido 1ø de Abril, 19 Abr 1982, 250 m, *J.F. Iribe 115* (MEXU); Ejido Portes Gil, *J.F Iribe 95* (MEXU); Estación Forlón, Sep 1985, *C.R. López 124* (MEXU); Estación San Francisco, Sep 1985, *J.L. Ramos 184* (MEXU); Llera-Río guayalejo, 1 Jun 1992, 280 m, *J.E. López de la Cruz 135* (MEXU); Tropic of Cancer on highway 85 at km 660, 3 Oct 1965, 300 m, *K. Roe 2401, E. Roe* (MEXU); Municipio de Matamoros, 32 km al SE de Matamoros, 10 km al SE del Rancho El Alteño, Jun 1964, *F. González 585* (MEXU); Isla Las Gallinas, frente al campo pesquero La Capilla. Laguna Madre, 10 Sep 1994, 10 m, *J.L. Mora 478* (UAT); El Soldado, Matamoros, *A. Brito s.n.* (IBUG); Municipio de Méndez, San Tomás, 19 Sep 1980, 110 m, *J.A. Barrientos 633* (COCA, MEXU); Municipio de Miguel Alemán, Brecha de Pemex, alt. 95, 25 Oct 1991, *C.R. López 200* (MEXU); Tamaulipas, 10 mi E of Linares, 8 Aug 1930, *H.H. Bartlett 10844* (MEXU); Municipio de Nuevo Laredo, 20 km al O de Ciudad Guerrero, Oct 1973, *F. González 6324, R M. López & R. Hernández* (MEXU); Municipio de Padilla, Campo Turístico Lago Vista, 13 Feb 1986, *P. Moya 89* (MEXU); Municipio de San Carlos, 1.5 km SE de Guayacán, Sierra San Carlos, 7 Dic 1984, 590 m, *O.L. Briones 1372* (ANSM); Ejido el Corralejo, 21 Aug 1980, 330 m, *R. Sandoval 14* (MEXU); Ejido La Gavia, 3 Sep 1981, 300 m, *J.F. Iribe 74* (MEXU); Ejido Puerto Rico, 3 Sep 1981, 200 m, *J.A. Barrientos 71* (MEXU); Rancho El Coyote, 19 Oct 1983, 300 m, *J.F. Iribe 205* (MEXU); San Miguel 2 km antes de Silva Sánchez, Mar 1970, 420 m, *F. González 2890, V.M. Toledo & E. Martínez* (MEXU); Santa Teresa, 4 Oct 1981, 330 m, *J.A. Barrientos 76* (MEXU); N de San Fernándo, *J.N. Rose 24336* (US); San Fernando, 10 mi from the San Fernando-Matamoros highway junction on the gravel road to Reynosa (junction of the dirt road to Mendez), 13 Nov 1959, 152 m, *M.C. Johnston 4705 J. Graham* (MEXU); Camino rumbo a Carboneros, 5 Jun 1987, 80 m, *R.A. Carranco 323* (MEXU); Ejido Palo Solo, 10 Feb 1994, 15 m, *J.F. Iribe 161, 394* (MEXU); El Charco del Nido, 42 km SE de San Fernando, 24 Ene 1985, 400 m, *R. Díaz 252* (UAT); 9 Feb 1994, 10 m, *J.E. López de la Cruz 159* (MEXU); Municipio de San Nicolás, Camino a San Nicolás, 4 Sep 1981, 400 m, *J.A. Barrientos 85* (COCA, IEB); Municipio de Soto la Marina, Ejido 5 de Mayo, 17 Sep 1981, 145 m, *A. Brito 11* (MEXU); Ejido 5 de Mayo, 18 Sep 1981, 155 m, *J.G. Galván 3* (MEXU); km 10, tramo Soto la Marina-Abasolo, 10 Oct 1991, 60 m, *O.M. Galván 517* (MEXU); La Coma, 14 May 1985, 60 m, *J.A. Franco 24* (MEXU); Rancho El 13, 21 Oct 1986, 85 m, *J.A. Franco 82* (MEXU); Rancho El Saúz, 23 Oct 1983, *A. Brito 167* (MEXU); Rancho Los Arroyos, 22 Oct 1986, 150 m, *J.F. Iribe 325* (MEXU); Rancho Los Tripones, 16 Jul 1986, *J.A. Franco 33* (MEXU); Rancho San Alfonso, 11 Feb 1981, *J.A. Barrientos 765* (COCA, IEB); Tramo San José de las Rusias-Ejido 5 de Mayo, 2 Oct 1986, 80 m, *J.G. Galván 67, 158* (MEXU); Municipio de Tula, Camino a San José de las Flores, 23 Oct 1986, 1280 m, *P. Moya 175* (MEXU); Camino al Ejido Tanque Blanco, 6 Nov 1986, 1080 m, *J.G. Galván 183, 191* (MEXU); Municipio de Victoria, 1 km from Victoria on the Matamoros highway, 2 Oct 1956, 350 m, *F. Martínez F-2246, G. Borja* (MEXU, US); Camino al Ejido La Reforma, 23 Oct 1986, 850 m, *J.E. López de la Cruz 14* (MEXU); Colonia La Estrella, Ciudad Victoria, 20 Sep 1985, 380 m, *M. Cisneros 55* (MEXU); Ejido Guadalupe Victoria, 17 Mar 1994, 330 m, *J.F. Iribe 407* (MEXU); Rancho El Abra, 18 Sep 1985, 330 m, *M. Cisneros 44* (MEXU); San Juan y el Ranchito, 18 Mar 1994, 200 m, *J.G. Galván 349* (MEXU); Santa Librada, 7 Sep 1983, 410 m, *J.F. Iribe 189* (MEXU); Victoria, Sierra de la Colmena, 19 Oct 1982, *J.F. Iribe 161* (MEXU); Villagrán, Ejido Guadalupe, 28 Jun 1983, 360 m, *J.F. Iribe 169* (MEXU); Garza Valdéz, 19 Nov 1986, 290 m, *M.H. Cervera 392* (MEXU).

24. Bouteloua uniflora Vasey, Bot. Gaz. 16:26. 1891. TIPO: U.S.A. TEXAS. Crockett Co.: 1890, *G.C. Nealley 222* (HOLOTIPO: US-2307997!; ISOTIPO: GH).

Plantas perennes, no rizomatosas. Culmos 10 a 60 cm de alto, delgados, glabros a escabrosos, erectos, simples, sin formar estolones. Vainas glabras a pubescentes; lígula de 0.5 a 1 mm largo, un anillo de pelos; láminas foliares de 6 a 20(–30) cm de largo y 1 a 2 mm de ancho, aplanadas, algo involutas hacia el ápice, involutas al secarse, escabrosas en ambas superficies, con algunos pelos de 2 a 4 mm de largo dispersos sobre los márgenes, más abundantes hacia la base. Inflorescencia de 5 a 15 cm de largo, con 15 a 70 ramificaciones primarias espigadas caedizas en la madurez; ramificaciones de 7 a 15 mm de largo, usualmente péndulas, con pedicelos cortos, menores de 0.5 mm de largo o sentadas, portando 1 (2) espiguillas; raquis triangular, hasta de 7 mm de largo. Espiguillas 7 a 9 mm de largo, permanecen insertas a las espigas, color pajizo-purpúreas; glumas desiguales, anchas, redondeadas a agudas en el ápice, escabroso-pubescentes sobre la nervadura central, delgadas, color verde-amarillento o con tintes purpúreos, primera gluma de 3 a 4 mm de largo, segunda gluma de 7 a 8 mm de largo; lema de 7 a 7.5 mm de largo, aguda, sin arista, glabra, con márgenes hialinos y ápice finamente escabroso; pálea 6.8 a 7 mm de largo. Anteras de 2.5 a 3 mm de largo, color amarillo limón, brillantes. Flósculo rudimentario ausente, o bien, representado por 1 a 3 aristas diminutas, la arista central más larga, de 2 a 3.5 mm de largo. Cariopsis de 2.2 a 2.5 mm de largo, color amarilla, ovoide a estrechamente elíptica.

CLAVE PARA LA DETERMINACIÓN DE LAS VARIEDADES DE *B. UNIFLORA*

1. Láminas foliares de 6 a 12 cm de largo, fuertemente curvas, en macollos basales; culmos de 10 a 30(–45) cm de largo; inflorescencias escaposas (sobresalen el follaje), con 15 a 30(–40) espigas ____ **23a. B. uniflora** var. **coahuilensis**

1. Láminas foliares de 15 a 30 cm de largo, rectas a ligeramente curvas, esparcidas en el culmo; culmos de 40 a 60 cm de largo; inflorecencias no sobresalen el follaje, con 50 a 70 espigas ________________ **23b. B. uniflora** var. **uniflora**

24a. Bouteloua uniflora Vasey var. **coahuilensis** Gould & Kapadia, Brittonia 16:191. 1964. (**Fig. 33**). Tipo: MÉXICO. Coahuila: Rancho Los Angeles, 40 km SW de Saltillo, 4 Nov 1962, *F.W. Gould 10300* (holotipo: TAES; isotipos: DS, GH, TEX, UC, US-2551355!).

Culmos de 10 a 30(–40) cm de alto. Vainas glabras a pubescentes; láminas foliares de 6 a 12 cm de largo, concentradas hacia la base de la planta, fuertemente curvas conforme se van secando, con pelos esparcidos hasta de 2 mm de largo en el margen cerca de la base. Inflorescencia escaposa, con 15 a 30(–40) ramificaciones primarias espigadas, portando generalmente 1 espiguilla, rara vez 2 (cerca de la base); raquis de 5 mm de largo. $2n=20$. Florece de junio a noviembre.

Comentarios.—Se le encuentra creciendo con *B. curtipendula* var. *caespitosa* cuyas plantas poco desarrolladas se parece a *B. uniflora* var. *coahuilensis*, se distingue de la primera por sus anteras color naranja.

Distribución.—Especie mexicana del N y Centro de México.

Hábitat.—Laderas rocosas secas con matorrales o pastizales; 220 a 2650 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Arteaga, Sierra Zapalinamé, E of Saltillo, 2 Sep 2005, 2100 m, *P.M. Peterson 18778, J. Valdés-Reyna* (US); Cerro de los Elotes, 1 Aug 1975, 220 m, *M.F. Robert 4466, J. Passini* (ANSM); Sierra de Arteaga, El Tunal, carr. Estatal 658, *P.S. Hoge 268* (US); *I.M. Johnston 7299* (US); Municipio de Castaños, Al pie de la Sierra La Gavia, km 117 carr. 57 Saltillo-Monclova, a un lado del Campamento San Lazaro, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1484* (CIIDIR, HUAA); Municipio de Nava, Sierra El Jardín, slopes above Canyon del Diablo, 2 Sep 2006, 1418 m, *P.M. Peterson 19904, S. Lara-Contreras* (US); Municipio de Saltillo, 1 mi N of Carneros, 8 Oct 1959, 1829 m, *M.C. Johnston 4192*^{a}, *J. Graham* (MEXU); Along road to Rancho Los Angeles, about 2 km E of junction with road to Zacatecas (Concepción del Oro, Zacatecas), limestone hills, 5 Sep 1991, 1981 m, *K.W. Allred 5524, J. Valdés-Reyna & J.T. Columbus* (ANSM); Area de reforestación de la Universidad Autónoma Agraria Antonio Narro, 3 Oct 1980, 1900 m, *J.A. Villarreal 884* (ANSM); Carneros, camino a la torre de microondas, 3 km O de la estación, 30 km S de Saltillo, 1400 m, *J. Espinosa* (ANSM); El Refugio, S de Saltillo, 1600 m, *E. Lyonnet 3552* (MEXU); La Encantada a 17 km de Saltillo carr. a Zacatecas, Sep 1976, 1600 m, *Grupo de Agrostología* (ANSM); Rancho experimental Los Angeles, 48 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zacatecas, 26 Aug 1981, 1800 m, *S.L. Hatch 4534* (ANSM); Area de Reforestación de la UAAAN Buenavista, *J.A. Villarreal 884* (ANSM); *D. Griffiths 8404* (US); Rancho "Los Angeles," 48 km al S de Saltillo, *S.L. Hatch, C.W. Morden & J. Valdés-Reyna 4534* (ANSM); *F.W. Gould & D. Watson 10538* (US); La Encantada, km 9 carr. Saltillo-Concepción del Oro, *Z. Morales, G. García & S. Inzunza s.n.* (CHAPA); Carneros, camino torre de microondas, 3 km al W de la estación, 30 km al S de Saltillo, *J. Espinoza 94* (ANSM); Rancho experimental Los Angeles, 48 km S de Saltillo, carretera 54 Saltillo-Concepción del Oro, Zac., 30 Sep 1978, 1800 m, *J. Santos Sierra s.n.* (ANSM); 16 Jul 1977, 2200 m, *J. Valdés-Reyna 1113* (ANSM); Municipio de Villa Ocampo, Sierra Madera del Carmen, Villa Ocampo, *J. Passini & M.F. Robert 5542A* (CHAPA). **Nuevo León:** Municipio de Doctor Arroyo, 21 km al N de Matehuala, San Luis Potosí, 19 Sep 1984, *P. Hiriart 312, 313, V. Juárez & R. Molczadzki* (MEXU); 30 km ENE of Doctor Arroyo, ENE of San Antonio de Peña Nevada, O base of Cerro Peña Nevada, 30 Jul 1983, 1950 m, *G.L. Neso 4733* (ANSM, MEXU); Municipio de Galeana, Sierra El pinal Alto, 1.1 mi N of San Pablo, 10 Sep 2005, 2507 m, *P.M. Peterson 18940, J. Valdés-Reyna* (US); 12 km SE of San Roberto on highway 58, 27 Aug 1981, 1845 m, *S.L. Hatch 4582, C.W. Morden & J. Valdés-Reyna* (ANSM); Rancho Aguililla, 26 Aug 1989, 1900 m, *G.B. Hinton 19588* (MEXU); 8 km al entronque de San Roberto, rumbo a Galeana, *Y. Herrera Arrieta & A. Cortés 1447* (CIIDIR, HUAA); km 150, carr. 57 Matehuala-Saltillo, a 20 km de San Roberto, *Y. Herrera Arrieta & A. Cortés 1451* (CIIDIR, HUAA); km 162, carr. 57 Matehuala-Saltillo, *Y. Herrera Arrieta & A. Cortés 1453* (CIIDIR, HUAA); 4 mi S de Galeana, *R.L. Mc Gregor, L.J. Harms, A.J. Robinson, R. del Rosario & R. Seagal 92* (US); 1 mi al E de San Marcos, 13 mi SW de Galeana, *F.W. Gould 10724, 10743, 10755* (US); Municipio de Iturbide, Ejido Santa Rosa, Iturbide, A.E. Estrada 1670 (UAG). **Tamaulipas:** Municipio de Miquihuana, Colonia Agrícola La Peña, 26 Feb 1981, 700 m, *J.F Iribe-Duarte 104* (MEXU); Ejido Valle Hermoso, cañón de la Sierra a Miquihuana, 4 Sep 1981, 2100 m, *R.A. Carranco 65* (MEXU); Rumbo al Aserradero, Sep 1981, 2650 m, *R.A. Carranco 71* (MEXU); Municipio de San Nicolás, Rancho La Trinidad, 19 Oct 1983, 650 m, *J.F. Iribe 203* (MEXU).

24b. Bouteloua uniflora var. **uniflora** Vasey. (**Fig. 34**).

Culmos de 40 a 60 cm alto, muy similar a la var. *coahuilensis*. Vainas glabras o casi glabras; láminas foliares de 15 a 30 cm de largo, bien distribuidas en los culmos, no concentradas hacia la base de la planta, no se curvan al secarse, con pelos de 3 a 4 mm de largo en el margen cerca de la base. Inflorescencia no escaposa, con 50 a 70 ramificaciones primarias espigadas, muy cercanas entre sí, portando 1 o 2 espiguillas sobre un raquis pubescente, hasta de 7 mm de largo. $2n = 20$. Florece de agosto a septiembre.

Distribución.—Desde Texas hasta México en Coahuila, Nuevo León y Tamaulipas.

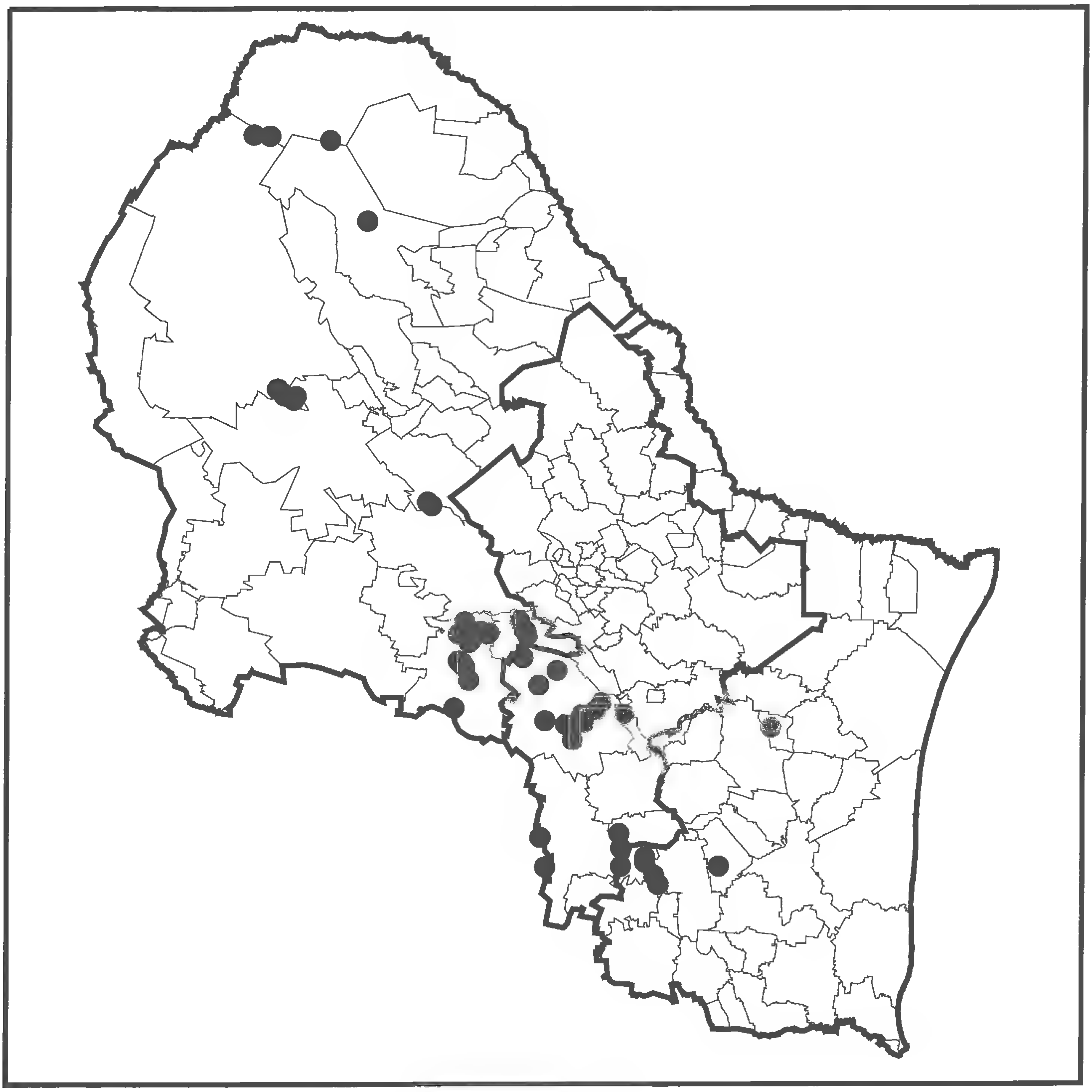


Fig. 33. Distribución de *Bouteloua uniflora* var. *coahuilensis* en el noreste de México.

Hábitat.—Suelos rocosos, laderas secas o moderadamente húmedas, en pastizales y matorrales; 600 a 2000 m.

Ejemplares examinados. **MÉXICO. Coahuila:** Municipio de Allende, 135.4 km NW of Muzquiz on Hwy 53 towards Boquilla del Carmen, 12 Sep 1991, 1380 m, *P.M. Peterson 10588, C.R. Annable* (US); Municipio de Castaños, S end of Puerto San Lazaro (Cuesta La Muralla), 0.5 mi N of San Lázaro along route 57, 28 Jul 1977, 1250 m, *J. Valdés-Reyna 1107, T.L. Wendt* (ANSM); Municipio de Acuña, Serranías del Burro, 12 km O del rancho el Bonito, cañón el Toro, 18 Sep 1977, 1625 m, *D.H. Riskind 2144* (ANSM); Serranías del Burro, 12 km O del rancho el Bonito, cañón el Toro, 18 Sep 1977, 1625 m, *J. Valdés-Reyna 1184, D.H. Riskind* (ANSM); Municipio de Arteaga, Sierra de Arteaga, El Tunal, carretera estatal 65, 17 Sep 1989, 2390 m, *P.S. Hoge 268, M.E. Barkworth & J. Valdés-Reyna* (ANSM); Municipio de Castaños, Al pie de la Sierra La Gavia, km 117 carr. 57 Saltillo-Monclova, a un lado del Campamento San Lazaro, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1486* (CIIDIR, HUAA); Municipio de Cuatrociénegas, Cañón del Agua (N-draining), mouth of canyon, vicinity of Ranchito, 25 Jul 1977, 1425 m, *J. Valdés-Reyna 1006, T.L. Wendt* (ANSM); Mounth of Cañada Los Posos (E-draining) in N foothill region of range, near of Tanque La Boquilla, 2.7 mi by road O of rancho Cerro de la Madera, 26 Jul 1977, 1420 m, *J. Valdés-Reyna 1049, T.L. Wendt* (ANSM);

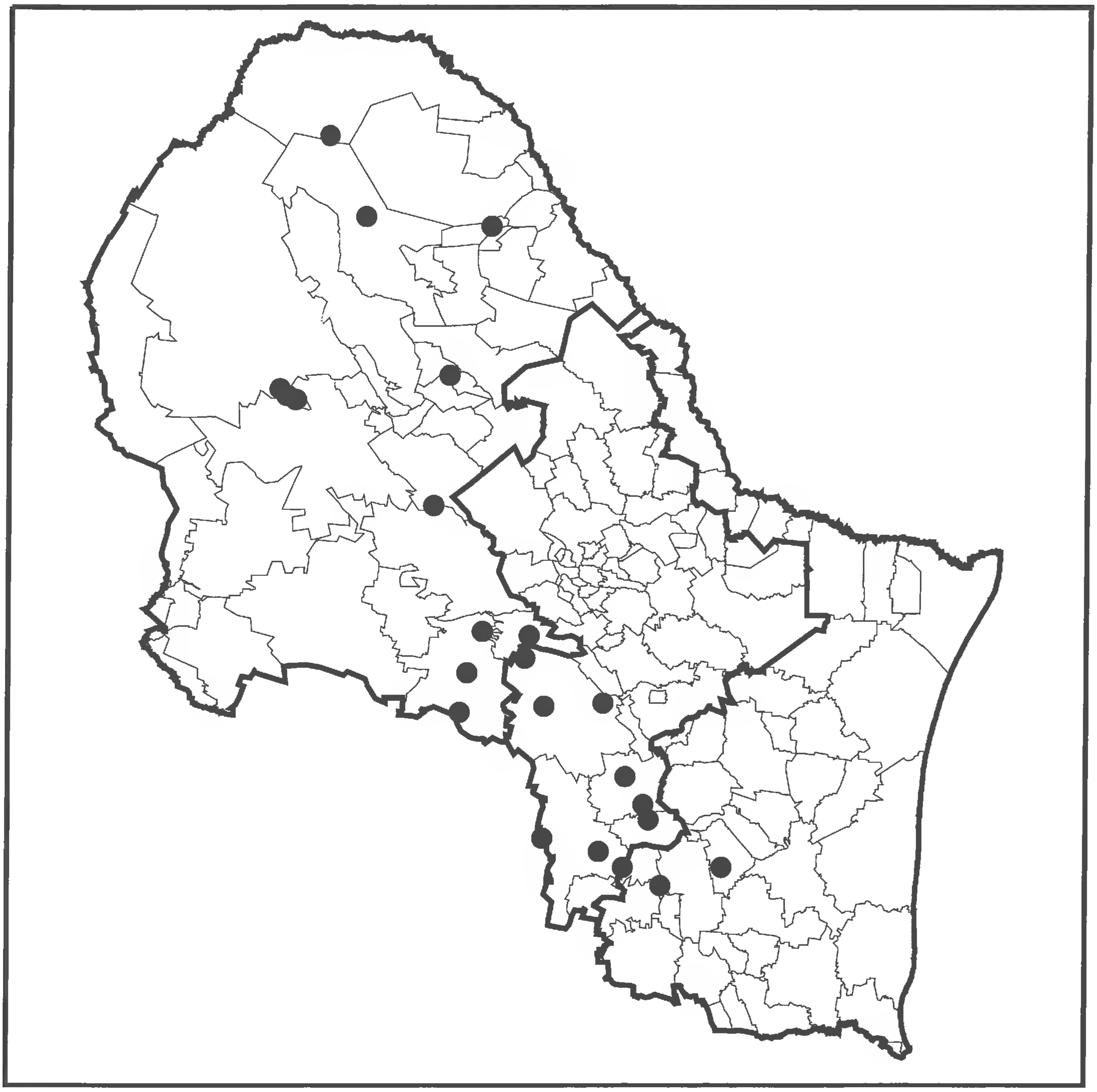


Fig. 34. Distribución de *Bouteloua uniflora* var. *uniflora* en el noreste de México.

Sierra de la Madera, vicinity of 'La Cueva' in Corte Blanco fork of Charretera Canyon, 11 Sep 1941, 1615 m, *I.M. Johnston 9060* (MEXU); Municipio de Saltillo, 53 km S of Saltillo, along highway 54, S of Concepción del Oro, Zac., 26 Aug 1981, 1850 m, *S.L. Hatch 4509, C.W. Morden & J. Valdés-Reyna* (ANSM); On highway 54 (road to Concepción del Oro), 6 km S of Saltillo, near Universidad Autónoma Agraria Antonio Narro, 18 Sep 1988, 1850 m, *M.E. Barkworth 5107, P.S. Hoge* (ANSM); Saltillo, 0.3 km E of Hwy to Zacatecas up to road to San Lorenzo, 10 Sep 1990, 1720 m, *P.M. Peterson 10552, C.R. Annable* (US); Municipio de Zaragoza, Rancho Santa Cruz, aproximadamente 81 km N de Múzquiz por la carretera Múzquiz-Boquillas del Carmen y 12 km de brecha NO rumbo a Santa Cruz, 23 Sep 1977, 600 m, *J. Valdés-Reyna 1286, L.E. Rodríguez* (ANSM). **Nuevo León:** Municipio de Aramberri, 75.8 km N of Dr. Arroyo on Hwy 61 and 3.2 km S of Ascensión (La Chona), 13 Oct 1991, 2100 m, *P.M. Peterson 11145, C.R. Annable* (US); Municipio de Doctor Arroyo, 21 km al N de Matehuala, San Luis Potosí, 19 Sep 1984, *P. Hiriart 316, V. Juárez y R. Molczadzki* (MEXU); Camino a Agua Nueva, 23 Jun 1981, 2000 m, *O.L. Briones 695* (ANSM); 9.4 mi W of San Antonio de Peña Nevada, 22 Sep 2002, 1807 m, *P.M. Peterson 16789, J. Valdés-Reyna & M. Sosa* (US); Municipio de Galeana, Alrededor de Galeana, Sep 1980, *J.A. Ochoa-Guillemar 1261* (MEXU); Navidad, carretera 57, km 85 al N de Saltillo, 23 Sep 1978, 1650 m, *F. Cárdenas & M.A. Bernal* (MEXU); 12.3 mi S of Milagro, 18 Sep 2003, 2040 m, *P.M. Peterson 17806, J. Valdés-Reyna & H.S. Hinton* (US); Municipio de General Zaragoza, 4 km S of Zaragoza at jct of road to Cerro Viejo-Tepehuanes, 20 Sep

2001, 1630 m, *P.M. Peterson 15848, J. Valdés-Reyna* (US). **Tamaulipas:** Municipio de Hidalgo, Sierra La Lagunita, 6.4 mi SE of Aramberri on road towards Agua Fría, 19 Sep 2002, 1397 m, *P.M. Peterson 16677, J. Valdés-Reyna & M. Sosa* (US); Municipio de Miquihuana, 15 km al SE de Miquihuana, 23 Aug 1984, *P. Hiriart 284, V. Juárez & R. Molczadzki* (MEXU); Municipio de Victoria, Altas Cumbres, 26 Oct 1980, 1100 m, *J.F. Iribe s.n.* (MEXU).

25. Bouteloua warnockii Gould & Kapadia, SouthW. Naturalist 7:176. 1962. (**Fig. 35**). Tipo: U.S.A. Texas. Culberson Co.: 2 mi W of Kent, 18 Jul 1961, *Gould & Kapadia 9533* (holotipo: TAES; isotipos MICH, MO!, SMU, SRSC, TEX, UC, US-2551367!).

Plantas perennes, caespitosas, formando macollos de 4 a 10 cm de diámetro, algunos con rizomas cortos. Culmos 20 a 35(–50) cm de alto, delgados, erectos, tiesos, sin ramificarse desde la base; nudos anteriores a la inflorescencia con tintes purpúreos. Hojas generalmente basales, verde-azulosas, con frecuencia glaucas; vainas estriadas, escabrosas con pelos tiesos, dispersos, de 1 a 1.5 mm de largo, obscureciendose con la edad (cambiando a color café); con un margen hialino, angosto, que forma dos pequeñas aurículas membranáceas, de 0.5 mm de largo, en la base de las láminas foliares; lígula de 0.5 a 1.5 mm de largo, un anillo de pelos y algunos pelos más largos de base papilosa; láminas foliares de 5 a 15(–25) cm de largo y 1 a 2(–3) mm de ancho, involutas y arqueadas, muy escabrosas en la superficie adaxial, con algunos pelos largos en el área cercana a la lígula y otros pocos de 5 mm de largo con bases papilosas en los márgenes, erectas y firmes, terminando en una punta muy fina. Inflorescencia de 5 a 15 cm de largo, exserta, con 9 a 25(–35) ramificaciones primarias espigadas espaciadas, inclinadas, caedizas en la madurez; espigas de 5 a 10 mm de largo, raquis aplanado, escabroso sobre los márgenes, portando (1-)2 a 6 espiguillas, apiñadas en el cuarto o tercio basal. Espiguillas de 5 a 6.5 mm de largo, permanecen insertas en las espigas, de color verde o con tintes purpúreos o cafés; glumas desiguales, agudas o acuminadas, primera gluma de 3 a 4 mm de largo, angosta, pubescente en la nervadura central y hacia el ápice, segunda gluma de 4 a 5.5 mm de largo, más ancha, acuminada, casi glabra a finamente pubescente en la nervadura central; lema de la flor perfecta 5 a 6.5 mm de largo, glabra, con el ápice trífido, las nervaduras laterales se prolongan en aristas cortas, de 0.5 a 1 mm de largo, gruesas, escabrosas; pálea glabra o con escasa pubescencia entre los nervios, de igual tamaño que la lema o un poco menor. Anteras de 2 a 2.2 mm de largo, color púrpura. Flósculo rudimentario 1, bien desarrollado, lema del flósculo de 5 a 6.5 mm de largo, con 3 aristas de 2.5 a 5 mm de largo, fuertes y escabrosas, ligeramente exsertas, arista central más larga. Cariopsis de 1.8 a 2.6 mm de largo, color amarillo, ovoide a estrechamente elíptica. $2n = 20$, con plantas aneuploides en Estados Unidos desde 21–40 (Gould, 1979). Florece de junio a agosto.

Distribución.—Desde Texas hasta México en Coahuila.

Hábitat.—Laderas pedregosas, cerca de arroyo, sobre suelos calizos; 1250 m.

Ejemplares examinados. **MÉXICO: Coahuila.** Municipio de Castaños, South end of Puerto San Lázaro (Cuesta la Muralla), 0.5 mi N of San Lázaro along Hwy 57, *J. Valdés-Reyna VR-1107* (ANSM); Municipio de San Pedro, 5.5 km al NW de Nueva Delicias, vertiente E de la Sierra de las Delicias, al N de San Pedro de las Colonias, *Y. Herrera Arrieta, M. de la Cerda & O. Rosales 1492* (CIIDIR, HUAA).

NOMBRES DUDOSOS Y EXCLUIDOS

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Erucaria tetrastachya Cerv., Naturaleza (México City) 1:349. 1870. Tipo: MÉXICO: = *Bouteloua barbata* Lag.? No revisado el tipo.

Bouteloua hirta var. *minor* Vasey ex L.H. Dewey, Contr. U.S. Natl. Herb. 2(3):531.1894. Tipo: U.S.A. Texas: Central Texas. No revisado el tipo.

Erucaria lutescens Cerv., Naturaleza (México City) 1:349. 1870. Tipo: MÉXICO: No revisado el tipo.

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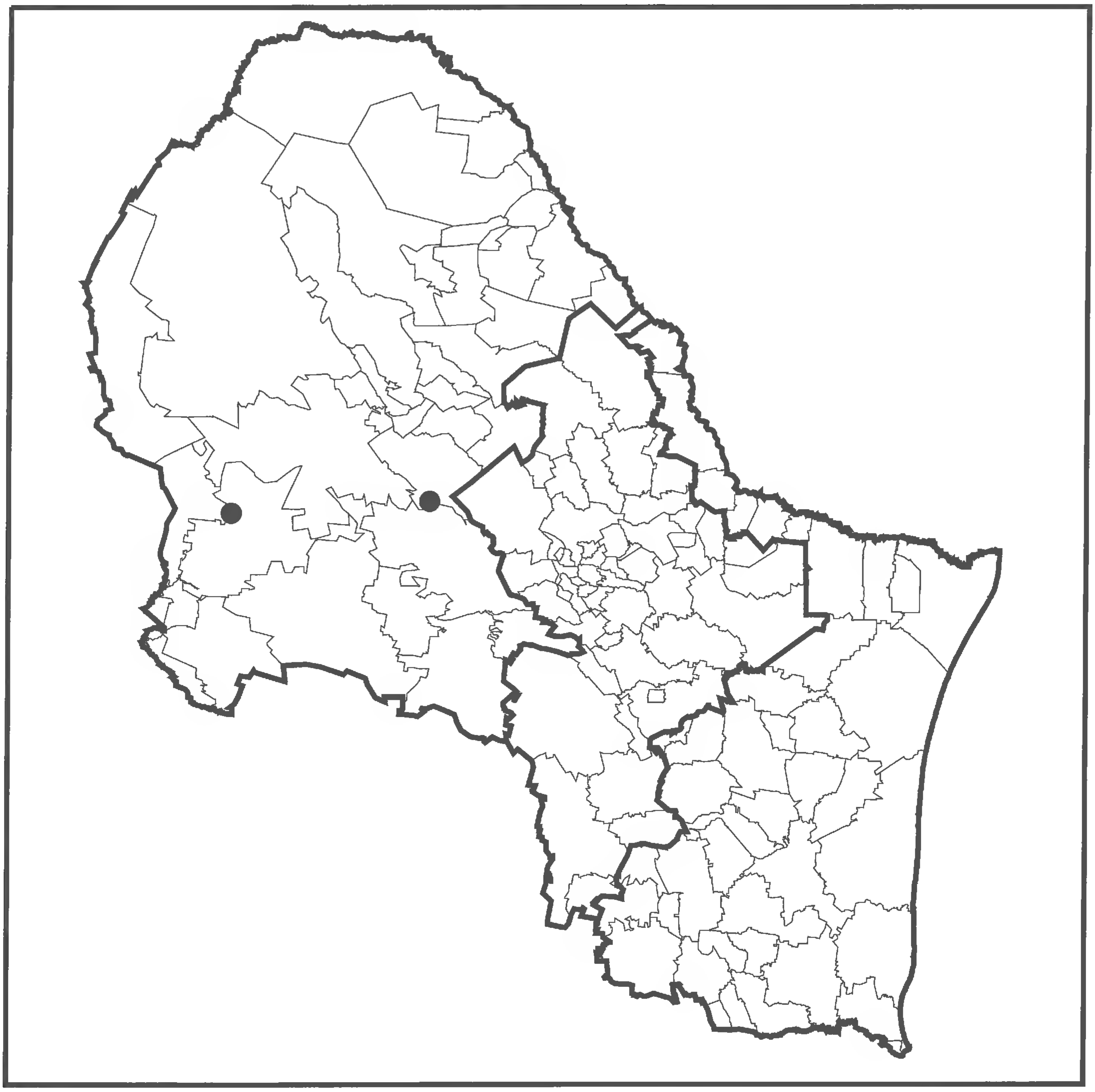

Fig. 35. Distribución de *Bouteloua warnockii* en el noreste de México.

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ANSM, ARIZ, B, BA, BAA, BM, CIIDIR, ENCB, GH, HERZU, HINT (herbario personal de George S. Hinton), HUAA, IBUG, INEGI, IZTA, K, LE, MEXU, MICH, MO, MSC, NMC, NMSU, NY, P, RM, RSA, SI, SLPM, TAES, TEX, UAT, US, UT, UTC, VT y W, se les agradece las facilidades y atenciones recibidas para hacer posible la revisión de los ejemplares a su cargo.

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BOOK REVIEW

Ada V. Segre. 2006. **The Gardens at San Lorenzo in Piacenza, 1656-1665.** In two parts: (ISBN 13: 978-0-88402-302-9, hbk.; ISBN 10: 0-88402-302-8, pbk.). Dunbarton Oaks Research Library and Collection, Washington D.C., U.S.A. (**Orders:** www.doaks.org; also available at www.hup.harvard.edu, 800-405-1619). $95.00. 107 pp., color photos, maps, and illustrations throughout with accompanying Manuscript Planting Notebook, 12 1/2" × 9 1/2".

Incredibly researched and exquisite in design, *The Gardens at San Lorenzo in Piacenza 1656–1665* was conceived by author Ada Segre while completing her Ph.D thesis on seventeenth-century Italian flower gardens. Coming across a reference to the existence of a five-hundred year old Italian planting notebook manuscript, she realized it could be of importance in revealing horticultural practices of the third quarter of seventeenth century Italy. Though too late to include in her thesis, she promised to return to this enigmatic garden journal housed in Dumbarton Oaks's Rare Books Collection and give it the comprehensive research it deserved. She spent two years on just finding evidence concerning the ownership of the garden described in the document. The evidence pointed to Margherita de' Medici Farnese, duchess of Parma and Piacenza, cities located south of the Po River in northern Italy.

The hardback book (with dust jacket), and reproductions in sepia tone of the 1663 garden design on the front and back endpapers, represents Segre's study. Inserted in the back of the study book are four painstaking, computer-driven topographical reconstructions of the flower gardens: *1656, the Nine Star Garden 1662, the Nine Star Garden 1664*, and *the Star-centered garden in 1665*. Accompanying the study book is the paperback reproduction of the anonymous Italian gardening notebook, also in sepia to capture the feel and look of the original. This seventeenth-century notebook records the plantings of three flower gardens at San Lorenzo. Here you may detect for yourself, and follow along with her investigations of these drawings and who might have made them. Both books are incased in a rich oxblood buckram-covered slipcase with blind embossing on the front.

Segre's reconstruction is supplemented by appendices that provide transcriptions and translations of the original manuscript, manuscript sources, and list of Plants at San Lorenzo, 1656–1665. Her work in this volume is a significant contribution to the field of garden conservation that will be of interest to specialists in landscape architecture, ornamental horticulture, and cultural history as well as to the general reader and book collector.—*Linny Heagy, Linny/Designer, Illustrator, email: a0005835@airmail.net.*

REVISION OF *TOCOYENA* (RUBIACEAE: GARDENIEAE) FROM THE STATES OF GOIÁS AND TOCANTINS AND A NEW SPECIES ENDEMIC TO WHITE-SAND AREAS IN THE BRAZILIAN CERRADO

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ABSTRACT

During the preparation of the Rubiaceae treatment for the *Flora de Goiás e Tocantins*, detailed field and herbarium observations were made on the species of *Tocoyena* Aubl. (Rubiaceae, Gardenieae) occurring in this area, and are presented here. Also, some recent collections of *Tocoyena* from white-sand areas in the states of Goiás and Tocantins attracted my attention to the vegetation of these areas. Although many studies are available on the vegetation of white sand areas of the Amazon Basin (known in Brazil as "campinas" or "campinaranas"), very little is known about the quartzitic white sand areas of the Cerrado Biome. A short discussion about these areas is presented, a new endemic species of *Tocoyena* is described and illustrated, and a call for urgent programs for the conservation of these areas is launched. A key to the species of *Tocoyena* encountered in the states of Goiás and Tocantins is also included.

Key Words: *Tocoyena*, Gardenieae, Rubiaceae, Goiás, Tocantins, white sands, Cerrado, Brazil, conservation

RESUMO

Durante a preparação do tratado das Rubiaceae para a *Flora de Goiás e Tocantins*, foram efetuadas detalhadas observações de campo e de amostras de herbário sobre ás espécies de *Tocoyena* Aubl. (Rubiaceae, Gardenieae) presentes nestes estados e são aqui apresentadas. Também, algumas coletas recentes de *Tocoyena* provenientes de áreas de areias brancas nos Estados de Goiás e Tocantins atraíram a minha atenção sobre estas localidades. Embora existam muitos estudos sobre áreas de areia branca na Bacia Amazônica (conhecidas no Brasil como "campinas" ou "campinaranas"), se sabe muito pouco sobre as áreas de areias brancas quartzíticas no Bioma Cerrado. Uma curta discussão sobre estas áreas é apresentada, uma nova espécie endêmica de *Tocoyena* é descrita e ilustrada, e um apelo por um urgente programa de conservação destas áreas é aqui lançado. Uma chave para as espécies de *Tocoyena* encontradas nos Estados de Goiás e Tocantins é também incluída.

Palavras Chave: *Tocoyena*, Gardenieae, Rubiaceae, Goiás, Tocantins, areias brancas, Cerrado, Brazil, conservação

During the preparation of the Rubiaceae treatment for the *Flora de Goiás e Tocantins*, detailed field and herbarium observations with taxonomic implications were made on the species of *Tocoyena* Aubl. (Rubiaceae, Gardenieae) occurring in this area. *Tocoyena* is a genus of about 25 species with Neotropical distribution, represented by subshrubs, shrubs and trees. The genus was divided into two groups by Schumann (1891) based on the shape of the corolla lobes and the lobed portion of the flower buds: 1) *Acutiflorae* K. Schum., with corolla lobes and flower buds acute [with *T. foetida* Poepp. & Endl. and *T. guianensis* K. Schum.]; 2) *Obtusiflorae* K. Schum., with corolla lobes and flower buds obtuse [with *T. formosa* (Cham. & Schltdl.) K. Schum., *T. brasiliensis* Mart., *T. sellowiana* (Cham. & Schltdl.) K. Schum. and *T. bullata* Mart.]. The taxonomic position of the genus has always been clear, as it has been placed in the tribe Gardenieae in all major classifications (Hooker 1873; Schumann 1889, 1891; Bremekamp 1934; Verdcourt 1958; Robbrecht & Puff 1986; Robbrecht 1988, 1993). Persson (1993, 1995, 1996, 2000) with morphological, palynological, and molecular studies confirmed its position in the Gardenieae.

Several floristic and taxonomic treatments are available for the South American species of *Tocoyena*. Schumann (1889) revised the species present in Brazil (and those of contiguous countries) recognizing six species. Steyermark (1965) presented a synopsis of *Tocoyena* for the *Flora of the Guayana Highlands* in which he

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recognized seven species, complemented by important taxonomic information. Taylor and Steyermark (2004) recognized six species present in Venezuela, five of which present in the Venezuelan Guayana.

Prado (1987) revised the species of *Tocoyena* occurring in Brazil, and maintained the two groups published by Schumann. The twelve species recognized in her revision are fully described, beautifully illustrated, with full synonymy, and many specimens cited. She also proposed two varieties for *T. formosa*, based mostly on vegetative characters. However, this study is a master dissertation, and the taxonomic novelties are not effectively published (McNeill et al. 2006: Art. 30.5).

Silberbauer-Gottsberger et al. (1992) revised the group *Obtusiflorae*, which is mostly distributed in the Brazilian Cerrado and Caatinga. The delimitation and synonymy of several species differed significantly from those of Prado. These authors proposed three varieties of *T. formosa*, supported by a multivariate analysis using mostly vegetative characters, resurrected *T. brasiliensis* as a separate species, and presented a key to all the species and varieties recognized in the group *Obtusiflorae*. Two recent floristic treatments of *Tocoyena* are also available from two states of Southern Brazil, Santa Catarina (Delprete et al. 2005) and São Paulo (Prado & Kinoshita 2007), dealing with one and three species, respectively.

The flowers of *Tocoyena* give off a pleasant scent, resembling that of *Gardenia* J. Ellis (Gardenieae), reaching its highest intensity at night, and are pollinated by several species of sphingid moths (Silberbauer-Gottsberger 1972; pers. obs.). Most species of *Tocoyena* have great ornamental potential, and it is surprising that they have not been brought into cultivation for this purpose. In addition, the fruits of all the species of the genus are an important food source for birds (e.g., macaws, parakeets, parrots), mammals (e.g., monkeys, marmosets, tamarins, agoutis, coatis, capybaras, and peccaries) and small marsupials (e.g., opossums) in most Neotropical habitats.

Recently, some collections of *Tocoyena* from white-sand areas in the states of Goiás and Tocantins attracted my attention to the vegetation of these localities. Many studies are available about white sand areas of the Amazon Basin, known in Brazil as "campinas" or "campinaranas," where they are more evident because of the dramatic difference between their savanic vegetation and the surrounding tall canopy forests typical of the lowland Amazon. Many classic studies on the phytosociology and floristic composition of these Amazonian areas are available, as, for example, those of Ducke (1907, 1913), Ducke & Black (1953, 1954), Gottsberger & Morawetz (1986), Anderson (1981), Prance (1996), Lisboa (1976), and Takeuchi (1960a, 1960b, 1960c, 1961, 1962), among many others. On the other hand, little is known about the vegetation of quartzitic white-sand areas within the Cerrado Biome; this is probably due to the fact that the contrast with the surrounding vegetation is not as striking as that of Amazonian white sands.

The floristic composition of white-sand areas in the Cerrado Biome is still largely unknown, as botanical collections in these areas are sparse and have been made only by botanists randomly passing through these areas. The most important factor influencing species composition in the Cerrado Biome is soil composition, as it has been amply demonstrated by many interdisciplinary studies, as for example those of Cole (1986, 1992), Emmerich (1990), and Haridasan (2001). As a consequence, the vegetation of these areas is made of two main components: 1) plant species also present in the surrounding Cerrado *sensu stricto*, but with smaller individuals than those growing in the surrounding savanna with red soil (pers. obs.), and 2) species of plants (and animals; e.g., Rodrigues et al. 2007) endemic to these areas. The new species of *Tocoyena* described below is certainly one of those narrow endemics. Finally, these white-sand areas are currently in extreme danger of being completely destroyed, as even some ecologists indicated to "encourage the construction of industries and housing in infertile or less fertile soils, as the white sand areas in several region of tabular interfluvium" (liberal translation from Ab'Saber 1990, p. 25), and these areas should be the subject of urgent conservation programs.

SYSTEMATIC TREATMENT

Tocoyena formosa (Cham. & Schltdl.) K. Schum. in Mart., Fl. Bras. 6(6):347. 1889. (**Fig. 1**). *Gardenia formosa* Cham. & Schltdl., Linnaea 4:200. 1829. TYPE: BRAZIL: Southern Brazil, without locality, s.d., *Sellow s.n.* (HOLOTYPE: B, destroyed, photo-B at NY).

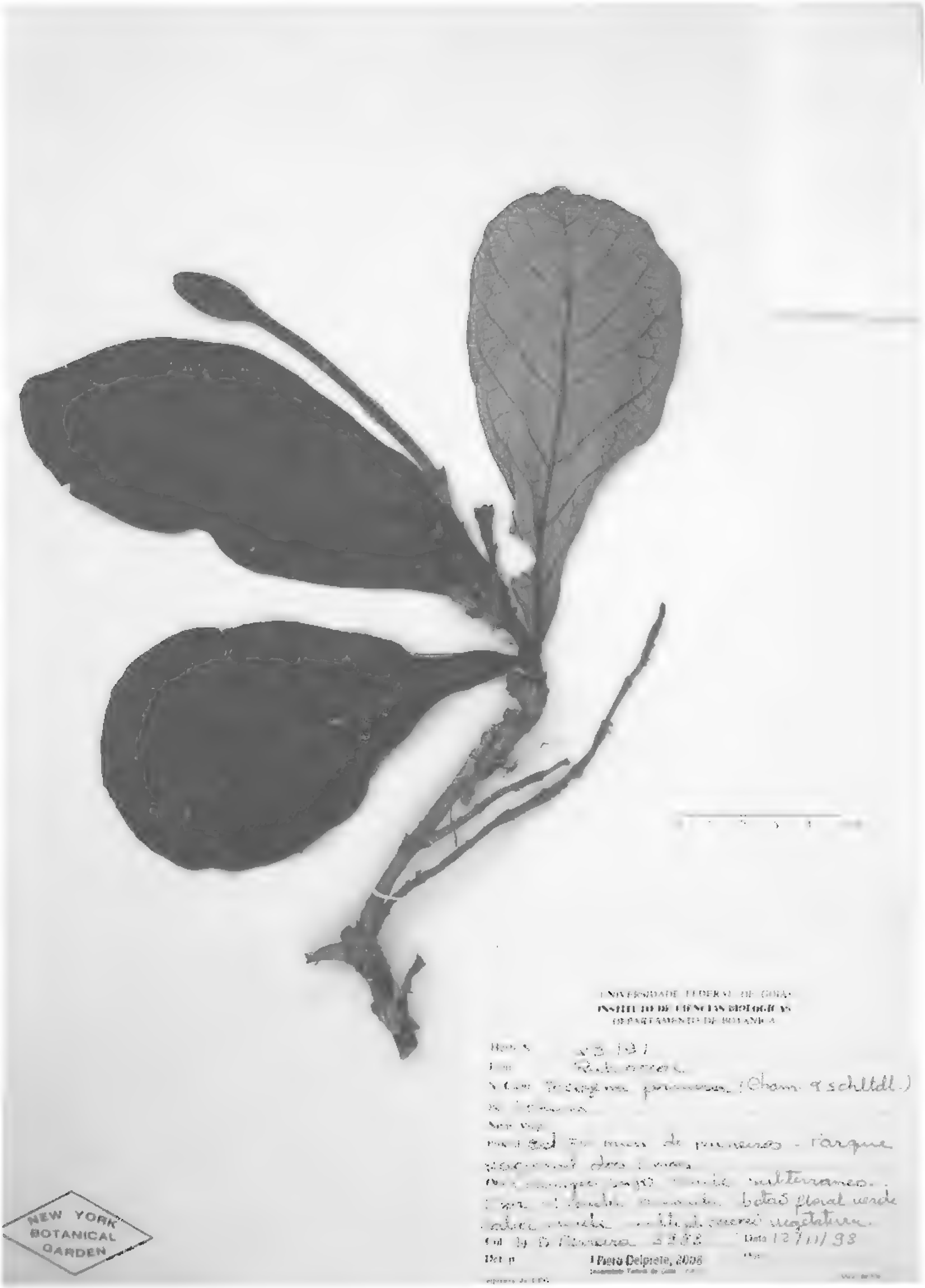
NEW YORK BOTANICAL GARDEN
(Cham. & schltdl.)
Pietro Delprete, 2006

Fig. 1. *Tocoyena formosa* (Cham. & Schltdl.) K. Schum. Individual with basal rosette of leaves sessile to the ground, with subterranean xylopodium (from *H.D. Ferreira 3988*, NY).

Tocoyena hirsuta Moric. ex DC., Prodr. 4:375. 1830. Type: BRAZIL: without locality, s.d., *Collector Unknown s.n.* (holotype: G-DC).

Tocoyena velutina Mart., Flora 24 II, Beibl. 6:81. 1841. Type: BRAZIL: Mato Grosso: Cuiabá, Aug [s.d.] (fl), *Martius s.n.* (holotype: M).

Tocoyena microdon Mart., Flora 24 II, Beibl. 6:82. 1841. *Tocoyena formosa* (Cham. & Schltdl.) K. Schum. var. *microdon* (Mart.) Gottsb. & Ehrend., Pl. Syst. Evol. 181:163. 1992. Type: BRAZIL: Maranhão: Rio Itapicurú, 1809 (fl), *Martius 3297* (holotype: M).

Tocoyena stipulosa K. Schum., Bot. Jahrb. Syst. 25, Beibl. 60:18. 1898. *Tocoyena stipulacea* K. Schum. ex Glaziou, Mém. Soc. Bot. France 1(3):343. 1909, nom. nud. Type: BRAZIL: Goiás: Between Macacos and Chico Costa, 9 Oct 1893 (fl), *Glaziou 21485* (holotype: B, destroyed, photo web!; isotypes: BR, C n.v., K n.v. photo web!, R; photo-B at NY).

Tocoyena mollis K. Krause, Notizbl. Königl. Bot. Gart. Berlin 6:202. 1915. Type: BRAZIL: Bahia: Remanso, catinga, Dec 1906 (fl), *Ule 7143* (holotype: B, destroyed, photo web!, isotype: L n.v.; photo-B at F, NY).

Tocoyena surinamensis Bremek., Rec. Trav. Bot. Neerl. 33:710. 1936. Type: SURINAME: upper Sipaliwini River, savanna near Platte Berge, 5 Dec 1935 (fl), *H.E. Rombouts 323* (holotype: U; isotypes: C n.v., K n.v. photo web!, MO, U, US).

Tocoyena formosa (Cham. & Schltdl.) K. Schum. var. *pseudobrasiliensis* Gottsb. & Ehrend., Pl. Syst. Evol. 181:162. 1992. Type: BRAZIL: São Paulo: Mun. Botucatú, 18 km N, 14 km E of São Manuel-Piracicaba highway, near ex-railway station Treze de Maio, 22°45'S, 48°25'W, 550 m, 1 Nov 1971, *I. Gottsberger & G. Gottsberger 11-11171* (holotype: UB; isotypes: BOTU, K n.v. photo web!, GI n.v., NY).

Taxonomic observations: Silberbauer-Gottsberger et al. (1992) recognized three widely sympatric varieties in *Tocoyena formosa*, according to the results of a multivariate analysis using vegetative characters and field observations in patches of Cerrado in the state of São Paulo (Southern Brazil). However, a study of about 900 herbarium specimens and personal field observations of this species throughout its range demonstrated that the leaves vary widely in shape and vestiture, ranging from densely pubescent to tomentose (or exceptionally glabrous and minutely bullate) within the same populations throughout Brazil, but the floral characters remain constant throughout its geographic distribution. For the above reasons, *T. formosa* is here treated as a plastic species with polymorphic vegetative characters, with the same delimitation proposed by Silberbauer-Gottsberger et al. (1992), but without any subspecific taxonomic ranks recognized.

In the southern portion of the state of Goiás, and more specifically in the Parque Nacional das Emas and the Serra dos Caiapós, several collections were made of individuals reduced to a basal rosette of leaves, practically sessile to the ground or with an aerial stem of up to 3–5 cm long, and a xylopodium trailing horizontally underground up to 70 cm in length (or maybe longer, as they were broken off by the collectors). Aside from the extremely reduced habit, the leaves, flowers and fruits of these individuals are practically identical to those with shrubby or arboreal habit (Figure 1). Because of this, these individuals are treated here as a sessile form of *T. formosa* without any taxonomic recognition. The reason for this peculiar habit is unknown, but, because all these individuals were collected in shrubby campos ("campos sujos") on sandy/rocky soils, it is probable that the depauperate soil low in nutrients and the frequent fires influenced their subterranean habit. The collections examined with sessile leaf rosettes are listed here: BRAZIL: **Goiás:** Mun. Mineiros, Parque Nacional das Emas, 11 Oct 1994 (fl), *H.D. Ferreira 2744* (NY, UFG), 12 Nov 1998 (fl), *H.D. Ferreira 3608* (UFG), 26 Feb 1995 (fr), *H.D. Ferreira & O. Silva 3452* (NY, UFG), 11 Oct 1994 (fl), *H.D. Ferreira 3900* (UFG), 12 Nov 1998 (fl), *H.D. Ferreira 3988* (NY, UFG); Serra do Caiapó, ca 60 km S of Caiapônia, on road to Jataí, 27 Oct 1964 (fl), *Irwin & Soderstrom 7425* (NY, RB).

Distribution and ecology.—Widely distributed in tropical South America, from Suriname and throughout Brazil and Paraguay. Subshrub, shrub or tree (exceptionally reduced to a sessile rosette with a subterranean xylopodium; Figure 1); highly plastic and adapted to a wide variety of habitats. One of the most representative species of Neotropical savannas (Brazilian Cerrado), mostly in shrubby savannas ("Cerrado sensu stricto"), but also encountered at gallery forest margins, in mesophytic forests ("Cerradão" of Brazil), shrubby *campos* ("campos sujos"), and on rocky outcrops ("campos rupestres"). Sometimes also found in disturbed vegetation or even as a pioneer species in secondary vegetation in the Cerrado Biome.

Selected specimens examined: BRAZIL: **Bahia:** Mun. São Desidério, dirt road between Roda Velha and Estiva, 725 m, 12°42'S, 45°48'W, 7 Nov 1997 (fl), *D. Alvarenga et al. 1024* (NY); Mun. Formosa do Rio Preto, Projeto Ouro Verde, Rod. Anel de Soja, 710 m, 11°26'S, 46°4'W, 14 Nov 1995 (fl), *B.M.T. Walter et al. 2927* (CEN, NY). **Tocantins:** Mun. Porto Nacional, 10 Oct 1993 (fl), *M. Alves s.n.* (HTO, NY); Mun. Pium, Ilha do bananal, Parque Nacional do Araguaia, Rio Javaés, 9°59'S, 50°7'W, 27 Mar 1999 (fr), *M.A. Alves et al. 4192* (IBGE); Mun. Dianópolis, 570 m, 11°40'S, 46°40'W, 30 Sep 2003 (fl), *T.B. Cavalcanti et al. 3385* (CEN); Mun. Porto Nacional, Área da FAB, 7 Aug 1993 (fl), *J. Ferreira et al. 4* (HTO); Mun. Araguaína, ca 10 km S of Araguaína, 300 m, 16 Mar 1968 (fr), *Irwin et al. 21237* (NY); Mun. Palmas, Serra do Lageado, between Rio Taquarassu and Rio Taquarassusinho, 48°13'S, 10°17'W, 13 Apr 1994 (fr), *I.V. Lima & F.P.R. de Jesus 274*

(HEPH, HTO), *275* (HEPH); Mun. Tupiratins, Córrego Almoço, 8°14'S, 48°9'W, 27 Oct 2000 (fl), *S.F. Lolis et al. 71* (HTO); Mun. Caseara, Parque Estadual do Cantão, 22 Jan 2000 (imm fr), *P.E. Nogueira & M. Richter 752* (IBGE, NY); road Taguatinga-Aurora do Norte, km 9, 6 Dec 1991 (fl), *B.A.S. Pereira et al. 2005* (IBGE, NY); Mun. Presidente Kennedy, road from BR-153 to Itaporã, 12 km W of Presidente Kennedy, Faz. Primavera, along Ribeirão Feínho, ca 3°25'S, 48°37'W, 400–500 m, 1 Feb 1980 (fr), *Plowman et al. 8259* (NY, UB); Transamazônica, junction of Nazaré, 10 Sep 1973 (fl), *Rizzo 9273* (NY, UB, UFG). **Goiás:** Mun. Niquelândia, dirt road 27 km from Colinas do Sul, near Rio Tocantinzinho, 14°11'S, 48°6'W, 480 m, 6 May 1998 (imm fr), *D. Alvarenga et al. 1164* (IBGE, NY); Mun. Nova Roma, road towards Iaciara, Faz. Santa Clara, 485 m, 13°45'S, 46°51'W, 29 Feb 2000 (fr), *D. Alvarenga et al. 1286* (CEN, IBGE, NY); Chapada dos Veadeiros, 13 km by rd S of Terezina, ca 1,000 m, 16 Mar 1973 (fr), *Anderson et al. 7254* (NY, UB); Serra Geral do Paraná, 7 km by rd of São João da Aliança, 1,100 m, 22 Mar 1973 (fr), *Anderson et al. 7677* (NY, UB); Mun. São Domingos, near Água Quente, Faz. São Domingo, 13°37'S, 46°44'W, 27 Oct 2000 (fl), *M.A. da Silva et al. 4558* (IBGE, NY); Mun. Campinaçu, Córrego Laginha, 13°47'S, 48°14'W, 495 m, 9 Oct 1991 (fl), *T.B. Cavalcanti et al. 901* (CEN, NY); Mun. Alto Paraíso, São Jorge, dirt road to Vale da Lua, 14°10'S, 47°46'W, 870 m, 19 Sep 1998 (fl), *Delprete et al. 6703* (BR, CAY, GB, HTO, NY, RB, UB, UFG); Mun. Alto Paraíso, Parque Nacional Chapada dos Veadeiros, Faz. Murungú, 23 Sep 1998 (fl), *Delprete et al. 6772* (BR, GB, HTO, NY, UB, UFG); Mun. Mineiros, Parque Nacional das Emas, road from Água Ruim to Furna Grande, 18°8'S, 52°44'W, 680 m, 5 Oct 1998 (st), *Delprete et al. 6817* (K, MO, NY, UB, UFG); Mun. Caiapônia, Serra dos Caiapós, road Caiapônia-Montevidiu, 5–20 km de Caiapônia, 17°5'S, 51°44'W, 680–700 m, 12 Oct 1998 (fl, imm fr), *Delprete et al. 6828* (GB, K, NY, NX, UB, UFG); Mun. Pirenópolis, Parque Estadual da Serra dos Pireneus, base do Morro do Cabeludo, 15°48'S, 48°49'W, 1280 m, 26 Nov 2005 (fl), *Delprete et al. 9323* (RB, UFG); Mun. Pirenópolis, Fazenda Quebra Rabicho, Córrego das Contenas, 15°44'S, 49°2'W, 8 Jul 2006 (fr), *Delprete et al. 9850* (NY, UFG); Mun. Mossâmendes, Serra Dourada, Reserva Biológica J.A. Rizzo, near housing, 26 Oct 1997 (fl), *Gomes-Klein et al. 3308* (NY[2], UFG), *3320* (NY, UFG); Serra dos Cristais, 17°S, 48°W, ca 2 km N of Cristalina, 1,250 m, 5 Nov 1965 (fl), *Irwin et al. 9905* (NY, UB); Serra do Rio Preto, 16°S, 47°W, ca 3 km E of Cabeceiras, 1,000 m, 19 Nov 1965 (fr), *Irwin et al. 10566* (NY, UB); Mun. Pirenópolis, Serra dos Pireneus, 16°S, 49°W, Dec 1965 (fl), *Irwin et al. 10869* (MO, NY, RB, UB); Serra dos Cristais, 17°S, 48°W, 10 km W of Cristalina, 1,200 m, 4 Mar 1966 (fr), *Irwin et al. 13448* (NY, UB); Serra Geral de Goiás, 14°S, 46°W, Rio da Prata, 6 km S of Posse, 800 m, 6 Apr 1966 (fr), *Irwin et al. 14419* (NY, UB); Mun. Monte Alegre, Faz. Nica, 530 m, 13°8'S, 46°39'W, 30 Oct 2000 (fr), *F.C.A. Oliveira et al. 1159* (CEN, IBGE, NY); Mun. Goiânia, rod. Goiânia-Guapó, Córrego Pindaíba, 3 Sep 1968 (fl), *Rizzo & Barbosa 2075* (NY, UFG); Mun. Brazlândia, Fazenda Alegre, 2 Oct 1990 (fl), *A.H. Salles 1758* (HEPH, IBGE, NY). **Distrito Federal:** Reserva Ecológica do IBGE, área da RECOR, 26 Sep 1977 (fl), *Heringer et al. 122* (IBGE), 23 Oct 1978 (fl), *681* (IBGE), 11 Oct 1982 (fl), *7525* (IBGE, UB); ca 5 km NE de Planaltina, on rd to São Gabriel de Goiás, 1,200 m, 16 Oct 1965 (fl), *Irwin et al. 9248* (NY); confluence of Riberão Bananal with Lagôa Paranoá, 975 m, 13 Jan 1966 (fr), *Irwin et al. 11627* (NY, UB); perto do Riberão Sobradinho, 15°44'S, 47°44'W, 1,000 m, 28 Sep 1981 (fl), *Kirkbride 4467* (NY, UB); Faz. Vale Verde, perto do Córrego Açude, 15°39'S, 47°28'W, 1050 m, 26 Aug 1981 (fl), *Kirkbride 4515* (NY, UB); Fazenda Água Limpa, Campo Experimental da UnB, 15°58'S, 47°55'W, 26 Sep 1983 (fl), *Kirkbride & L.V. Ferreira 5397* (NY); Brasília, Parque Ecológico Norte Burle Marx, 23 Oct 2003 (fl), *J.R. Santos & G.A. Moreira 120* (CEN). **Minas Gerais:** Mun. Paraopeba, 30 Nov 1965 (fl), *R. Goodland 251* (NY); ca 25 km W of Montes Claros, road to Água Boa, 1,000 m, 23 Feb 1969 (fr), *Irwin et al. 23719* (NY); Mun. Patrocínio, ca 4 km N of Patrocínio, 1,000 m, 31 Jan 1970 (fr), *Irwin et al. 25735* (NY); Mun. Formoso, Parque Nacional Grande Sertão Vereda, Fazenda Mato Grande, Córrego Mato Grande, near waterfall, 770 m, 15°19'S, 45°59'W, 18 Oct 1997 (fl), *R.C. Mendonça et al. 3200* (IBGE, NY); Mun. Corinto, Fazenda do Diamante, base of Serra do Anjico, 600 m, 15 Apr 1931 (fr), *Y. Mexias 5630* (NY); Estrada Três Marias a Corinto, km 62, beira de cerradão, 30 Nov 1976 (fl), *G.J. Shepherd et al. 3827* (NY). **São Paulo:** Mun. Botucatú, 18 km N, 14 km E of São Manuel-Piracicaba highway, near ex-railway station Treze de Maio, 22°45'S, 48°25'W, 550 m, *I. Gottsberger & G. Gottsberger 2222-1* (BOTU n.v., GI n.v., NY, UB).

Tocoyena brasiliensis Mart., Flora 24 II, Beibl. 6:82. 1841. Type: BRAZIL: Rio de Janeiro: "Monte Telegraphi prope Sebastianopolin," June [s.d.], *Luschnath in Martius Herb. Fl. Brasil. s.n.* (holotype: BR).

Taxonomic observations.—*Tocoyena brasiliensis* was treated as synonymous to *T. sellowiana* (Cham. & Schltdl.) K. Schum. by Prado (1987). Silberbauer-Gottsberger et al. (1992) treated it as a distinct species because of the "corolla tube entrance villous; leaves obovate, 15–17 × 6–7.5 cm (vs. "corolla tube entrance glabrous; leaves oblong-lanceolate, smaller, mostly 7–9 × 2.5–3.5 cm" in *T. sellowiana*). Delprete (2005) also treated *T. sellowiana* as a distinct species, occurring from Bahia to Rio de Janeiro and Santa Catarina. Prado and Kinoshita (2007) treated them as distinct species, but also wrote that further studies might demonstrate that in fact they are synonymous.

Tocoyena brasiliensis is also similar to *T. formosa*, from which it is easily distinguished by the leaf blades completely glabrous or rarely with puberulent secondary veins below and plane (vs. variously pubescent or rarely glabrous and microscopically bullate) and for the vegetative and reproductive parts turning brownish-black when dry (vs. turning olive green to brown when dry).

Distribution and ecology.—Widely distributed in Brazil, from Amapá, Pará, Maranhão, Pernambuco, Bahia, Mato Grosso, Tocantins, Goiás, Minas Gerais to São Paulo. Shrub or small tree encountered in gallery forests sometimes seasonally inundated, and less frequently in mesophytic forests, shrubby savanna and rocky outcrops with superficial water table.

Selected specimens examined: **BRAZIL: Tocantins:** Mun. Couto-Magalhães, road Couto Magalhães-Colinas de Tocantins, 5 km from Couto Magalhães, 8°19'29"S, 49°9'25"W, 200 m, 4 Nov 2005 (fl), *Delprete et al. 9266* (CAY, HPL, HTO, NY, UFG); Mun. Goiatins, Aldeia Rio Vermelho, 230 m, 8°2'S, 47°15'W, 16 Apr 2001 (fr), *E.S.G. Guarino & J.P. Krahô 750* (CEN); 10 km S of Araguaína, 300 m, 16 Mar 1968 (fr), *Irwin et al. 21237* (NY, UB); Mun. Lajeado, Faz. Ribeirão dos Mares, Rio Tocantins, 0788531, 8915570 UTM, 22 Oct 1999 (fl), *S.F. Lolis et al. 318* (HTO); Mun. Porto Nacional, 10 km from Posto do Trevo, 18 Nov 1997 (fl), *L. Silva et al. s.n.* (HTO, UFG); Mun. Miracema do Norte [now Miracema do Tocantins], Aldeia dos Índios Xerente, 20 km from Miracema do Norte, 200 m, 9°53'S, 48°36'W, 11 Apr 1988 (st), *L.A. Skorupa & J.N. Silveira 431* (CEN); Mun. Palmas, Rio Tocantins, 9°59'39"S, 48°20'49"W, 9 Oct 2000 (fl), *E.A. Soares et al. 1013* (HTO); Mun. Lajeado, road Palmas-Lajeado, 9°57'S, 48°20'W, 10 Oct 2001 (fl), *E.A. Soares et al. 1623* (HTO); Mun. Brejinho de Nazaré, Faz. Santa Angelina, Reserva 1, 11°6'47"S, 48°41'20"W, 5 Nov 2001 (fl), *E.A. Soares et al. 1696* (HTO). **Goiás:** Mun. Niquelândia, Faz. Limoeiro, 420 m, 25 Nov 1992 (fl), *S.P. Cordovil et al. 172* (CEN); Mun. Mineiros, Parque Nacional das Emas, Rio Jacuba, 17°54'S, 52°52'W, 790 m, 2 Oct 1998 (fl), *Delprete et al. 6802* (GB, K, NY, RB, UB, UFG); Mun. Mineiros, Parque Nacional das Emas, área 3, 21 Oct 1989 (fl), *H.D. Ferreira 2093* (NY, UFG); Serra dos Pireneus, 16°S, 49°W, ca 12 km S of Corumbá de Goiás, 1,000 m, 1 Dec 1965 (fl), *Irwin et al. 10869* (NY, UB); Mun. Alvorada do Norte, Fazenda Largomar, 550 m, 14°31'S, 46°34'W, 28 Nov 2003 (fl), *A.C. Sevilha et al. 3616* (CEN); Mun. Serranópolis, RPPN Pousada das Araras, 51°59'W, 18°26'S, 560 m, 25 Oct 2005 (fl), *L.F. Souza et al. 1232* (UFG); Mun. Caldas Novas, Alternativa 9, margin of Rio Corumbá, 17°42'S, 48°32'W, 720 m, 27 Oct 1993 (fl), *R.F. Vieira et al. 1740* (CEN). **Distrito Federal:** Campus of the Universidade de Brasília, 14 Nov 1978 (fl), *Heringer 17172* (IBGE, UB); just outside of Reserva Biológica Águas Emendadas, 3 Sep 1995 (fl), *C. Proença et al. 1500* (UB). **Mato Grosso:** Mun. Santa Terezina, Faz. Codeara, Serra da Viúva, 12 km S of Santa Terezina, 10°40'S, 50°35'W, 10 Oct 1985 (fl), *C.A. Cid Ferreira et al. 6404* (NY); Mun. Brilhante, Fazenda Progresso, 28 Oct 1970 (fl), *Hatschbach 25286* (NY). **Mato Grosso do Sul:** Mun. Três Lagoas, Fazenda Dr. José Mendes, 12°30'S, 40°29'W, 20 Oct 1964 (fl), *J.C. Gomes 2369* (NY).

Tocoyena viscidula Mart., Flora 24 II, Beibl. 6:80. 1841. Type: BRAZIL: Bahia: "in silvis Caatinga mediterraneis," s.d., *Martius s.n.* (holotype: M n.v.; photo-M at UEC n.v., UFMT).

Taxonomic observations.—Schumann (1889) treated *Tocoyena viscidula* Mart. as a synonym of *T. formosa*, without any additional comments. Prado (1987) and Silberbauer-Gottsberger et al. (1992) recognized this species as rare and distinct, mostly because of observations made on 20th century collections. Accordingly, it is treated here as a distinct species, easily recognizable by its leaf blades densely lanate on both sides.

Distribution and ecology.—A species mostly collected in the State of Goiás and the Distrito Federal, with just a few collections known from the states of Bahia (where the type is from) and Piauí. A small shrub 10–70(–200) cm tall, encountered only in shrubby fields ("campos sujos") and rocky outcrops ("campos rupestres") within the Caatinga and Cerrado Biomes.

Conservation.—A rare species that needs to be added to the category of critically endangered taxa, as the last collections known were made in 1980–81. The habitats of this species are in need of an urgent conservation program.

Phenology.—Flowering specimens were collected during the rainy season, from August to November, and the only fruiting collecting known was made in February.

Specimens examined: **BRAZIL: Goiás:** Mun. Cristalina, Serra dos Cristais, 7 Oct 1981 (fl), *Hatschbach 44060* (MBM, UB); Mun. São João da Aliança, 21 km from Nossa Senhora de São Gabriel de Goiás, 1,000 m, 14 Oct 1980 (fl), *G. Martinelli et al. 7485* (UB). **Distrito Federal:** Fazenda Água Limpa, Campus da UnB, 47°56'S, 15°57°W, 16 Oct 1979 (fl), *César 638* (UB); Brasília, TV Record, 23 Oct 1978 (fl), *Heringer et al. 681* (UB); Brasília, Saia Velha, R-1, 10 Feb 1961 (fr), *Heringer 8135/329* (UB); Brasília, D.N.E.R., 10 Oct 1962 (fl), *Heringer 9046* (NY, UB); Brasília, Saia Velha, 22 Nov 1964 (fl), *Heringer 9964* (NY, RB, UB); Brasília, Catetinho, 15 Nov 1973 (fl), *Heringer 13005* (UB); Fazenda Água Limpa, Campus da UnB, Vargem Bonita, ca 18 km from Brasília TV tower, 8 Oct 1976 (fl), *Ratter et al. 3736* (UB).

Tocoyena arenicola Delprete, sp. nov. (**Fig. 2**). Type: BRAZIL: Tocantins: Mun. Miracema do Tocantins, road towards Lajeado (TO-070), 3 km from Miracema do Tocantins, cerrado vegetation on white sand, 9°35'13"S, 48°24'32"W, 230 m, 3 Nov 2005 (fl, fr), *P.G. Delprete, H. Lorenzi, J.A. Lombardi & E.G. Gonçalves 9249* (holotype: UFG; isotypes: CAY, HPL, MO, NY, RB, UB).

Tocoyenae formosae similis sed differt statura suffruticis 0.3–1 m altae caulibus 5–15 e xylopodio emergentibus (nec statura fruticis vel arboris usque ad 10 m (vel paulo ultra) altae vulgo trunco ad 20 cm crasso suffultae, vel raro solummodo in rosulam basalem e xylopodio horizontale ortam evoluta), praeterea corollis 3.6–6.5 cm longis (nec 8.5–14 cm longis) et laminis foliorum minoribus bene distincta.

Subshrubs to small shrubs 0.3–1 m tall, with 5–15 stems originating from a single xylopodium; stems simple or few-branched, terete or slightly laterally compressed, erect-pubescent to tomentose; bark papyraceous,

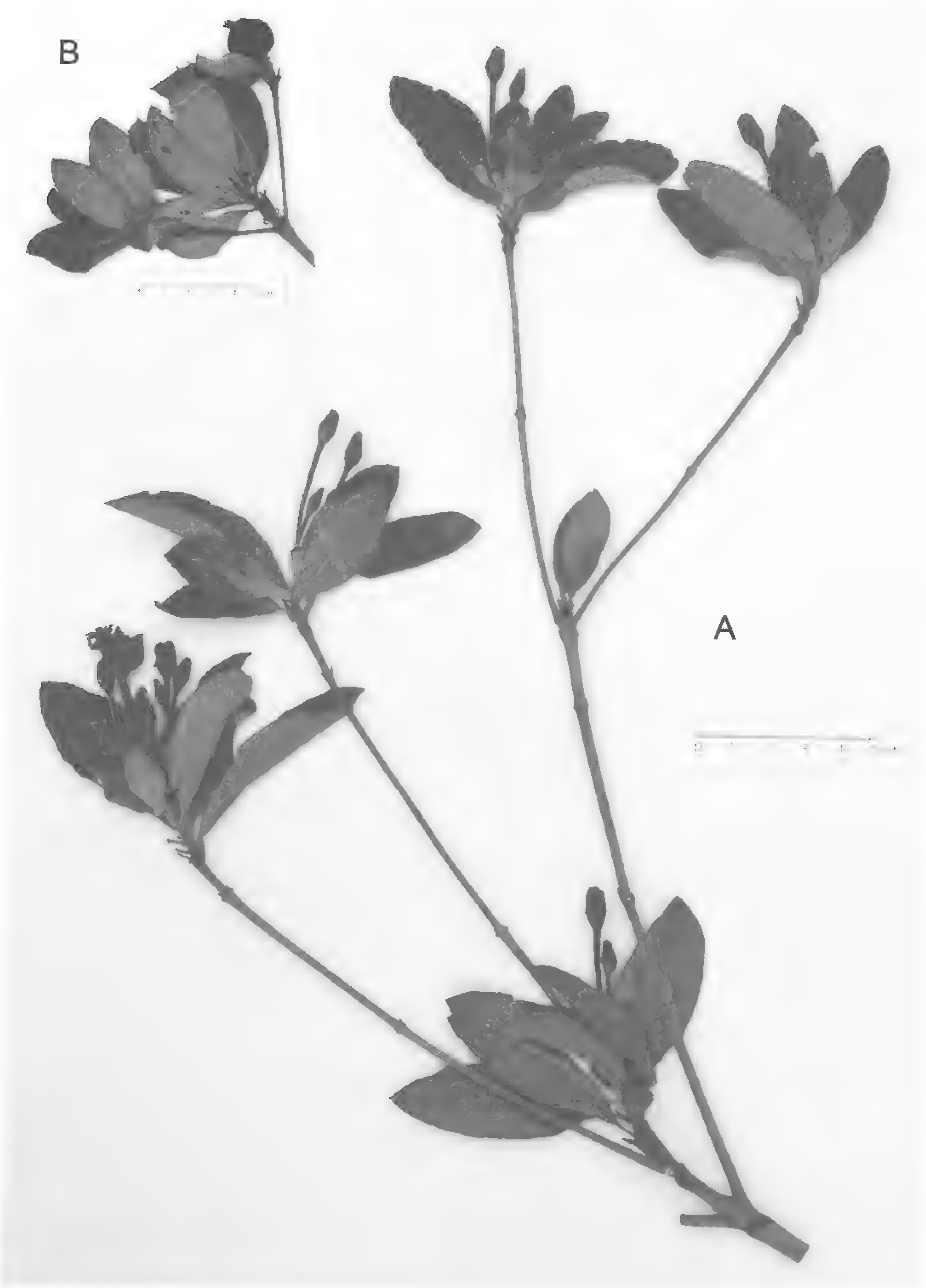

Fig. 2. Holotype of *Tocoyena arenicola* Delprete. A. Branch with flower buds and flowers in anthesis. B. Detail of a branch with a mature fruit (from *P.G. Delprete et al. 9249*, UFG).

pale brown to reddish-brown. **Stipules** narrowly triangular, oblong-triangular to lanceolate, 6–12 × 3–4 mm, acute to acuminate, glabrous or sparsely-pubescent outside, margins glabrous or ciliate, covered with coleters at basal portion and glabrous distally inside, persistent. **Leaves** subsessile to short-petiolate; petioles 2–10 mm long, canaliculate, densely pubescent; blades elliptic, oblong-elliptic to obovate, 1.5–6.5(–10.5) × 0.5–3(–5.5) cm, acute at base, obtuse to acute at apex, papyraceous to subcoriaceous, plane or microbullate, sparsely to densely pubescent above, tomentose-pubescent below, olive green to dark brown above and olive green below when dry; with 8–11 secondary veins each side. **Inflorescences** condensed-cymose, 3–11-florous; sessile to short-pedunculate, peduncles to 10 mm long; rachis antrorse-pubescent, hairs pale brown; secondary branchlets 1–7 mm long; bracts deltoid to narrowly triangular, 0.5–3 mm long, glabrous or sparsely pubescent, persistent. **Flower buds** pale green, lobed portion obtuse. **Flowers** sessile (terminal ones) or subsessile (lateral ones). Hypanthium turbinate, 3.5–4.5 mm long, glabrous or sparsely pubescent. Calyx cupular or short-tubular, 3–5 mm long, 5-lobed, glabrous or sparsely pubescent outside, with a few colleters among the teeth inside; lobes triangular to lanceolate, 1.5–3.5 mm long, ciliate. Corolla hypocrateriform, 3.6–6.5 cm long, white or cream-white, turning yellow at final stage of anthesis, hirtellous to erect-pubescent outside, glabrous inside, dark brown when dry; tube narrowly cylindrical, 3–6 cm long, slightly ampliate near the mouth; lobes elliptic to oblong-ovate, 6–10 × 8–9 mm, slightly asymmetrical, obtuse, puncticulate inside, margins ciliate. Stamens sessile to subsessile; anthers oblong, 4–5 mm long, shortly-apiculate, base bilobed. Style exserted, 3.5–6.5 cm long, thickened-clavate distally, glabrous; style branches narrowly obovate, 4–4.5 mm long, dorsally tricostate. **Fruit** globose or subglobose, 1.8–2 cm in diam, smooth (not ribbed), green and puberulent when young, yellow and glabrescent when ripe, turning black when dry.

Taxonomic observations.—*Tocoyena arenicola* Delprete is similar to *T. viscidula* in being a subshrub with a basal xylopodium, from which it is easily distinguishable by the characters given in the key (see below). However, because of the vestiture of the vegetative and reproductive parts it is most similar to *T. formosa* with which it has sometimes been confused. *Tocoyena arenicola* differs from *T. formosa* because it is a subshrub to small shrub 0.3–1 m tall, with 5–15 stems originating from a single xylopodium (vs. shrub or treelet to tree (0.5–)3–10(–12) m tall, commonly with a main trunk up to 20 cm dbh or exceptionally reduced to a single basal rosette of leaves and a horizontal xylopodium), with corollas 3.6–6.5 cm long (vs. 8.5–14 cm long), and leaf blades 1.5–6.5(–10.5) × 0.5–3(–5.5) cm (vs. (7–)9–20(–24) × (5–)8–15 cm).

Distribution and ecology.—A species known from a few collections in the extreme north of the state of Goiás (Mun. Posse) and the central-southern region of the state of Tocantins (Mun. Dianópolis and Miracema do Tocantins). Subshrub to small shrub, heliophilous, with a short basal xylopodium, and found only in shrubby fields ("campos sujos") on quartzitic white sands within the Cerrado Biome, sometimes in association with *Melocactus* spp. (Cactaceae) and *Syagrus acaulis* (Drude ex Mart.) Becc. (Palmae). The vegetation present in these white-sand areas contains species also common in the Cerrado Biome, but stunted and much smaller than when growing in the surrounding savanna with regular red soil (pers. obs.). In addition, it also contains a suite of species endemic to these areas, and *Tocoyena arenicola* is one of those.

Conservation.—Known by just a few collections, it is a rare species that must be placed in the category of imminent threat of extinction. This is supported by the fact that white-sand areas in the Cerrado Biome are primarily utilized for the construction of houses and buildings, as they are not suitable for agriculture and cattle ranching. In general, these areas should be urgently conserved, as they support many rare and endangered species of plants and animals.

Phenology.—Flowering and fruiting collections were realized from September to November.

Additional specimens examined: **BRAZIL: Goiás:** Mun. Posse, Nova Vista, campo cerrado, 8 Oct 1976 (fl), *Hatschbach 39048* (MBM, NY); Mun. Posse, dirt road to airport, cerrado recently burned, sandy soil, 820 m, 14°6'S, 46°20'W, 16 Oct 2001 (fl), *R.C. Mendonça et al. 4450* (CEN, IBGE); Mun. Posse, road between Guarani and Posse, sandy soil, 830 m, 14°57'S, 46°22'W, 19 Oct 2001 (fl), *R.C. Mendonça et al. 4508* (CEN, IBGE). **Tocantins:** Mun. Dianópolis, open cerrado on quartzitic sand, 660 m, 11°37'S, 46°26'W, 28 Sep 2003 (fl), *T.B. Cavalcanti et al. 3233* (CEN); Mun. Miracema do Tocantins, road towards Lajeado (TO-070), 3 km from Miracema do Tocantins, cerrado on white sand, 9°35'13"S, 48°24'32"W, 230 m, 3 Nov 2005 (fl, fr), *Delprete et al. 9252* (CAY, HTO, NY, SP, UFG); Mun. Dianópolis, area with quartzitic sand, 720 m, 11°36'S, 46°28'W, 25 Sep 2003 (fl), *A.O. Scariot et al. 759* (CEN).

KEY TO THE NATIVE SPECIES OF *TOCOYENA* IN THE STATES OF GOIÁS AND TOCANTINS, BRAZIL

1. Subshrub to small shrub 0.1–1(–2) m tall, with 3–15 stems originating from a basal xylopodium.
  2. Leaf blades 7–17 × 6–11 cm, densely lanate on both sides; corollas 10–12.5 cm long (tube 8.5–11 cm long), hirsute-pubescent (shrubby fields and rocky outcrops) ____ **T. viscidula**
  2. Leaf blades 1.5–7 × 0.7–3 cm, adpressed-pubescent above, sparsely lanate below; corollas 3.6–6.5 cm long (tube 3–6 cm long), hirtellous (shrubby fields on quartzitic white-sand) ____ **T. arenicola**
1. Shrub, treelet to tree (0.5–)3–10(–12) m tall, commonly with a main trunk up to 20 cm dbh (exceptionally individuals reduced to a basal rosette of leaves and with a horizontal xylopodium in *T. formosa*, in open fields in the Parque Nacional das Emas and in the Serra dos Caiapós).
  3. Leaf blades chartaceous to papyraceous, plane, completely glabrous or rarely with puberulent veins below, dark brown to black when dry; corollas glabrous externally ____ **T. brasiliensis**
  3. Leaf blades papyraceous to coriaceous, plane or minutely bullate, pubescent, velutinous-tomentose, hispid or rarely glabrous above, pubescent, velutinous-tomentose or rarely glabrous below, grayish, olive green to pale brown when dry; corollas tomentose, puberulent or glabrescent externally ____ **T. formosa**

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BOOK REVIEW

AMY STEWART. 2007. **Flower Confidential: the Good, the Bad, and the Beautiful in the Business of Flowers.** (ISBN 13: 978-1-56512-438-7; ISBN 10: 1-56512-438-3, hbk.). Algonquin Books of Chapel Hill, P.O. Box 2225, Chapel Hill, North Carolina 27515-2225, U.S.A. (**Orders:** www.indiebound.org, www.powells.com, www.amazon.com, www.barnesandnoble.com). $13.95, 306 pp., black/white photographs and illustrations, 8" × 5 1/2".

Flower Confidential is an un-jaundiced reportage of the floriculture industry worldwide. How does a simple flower—the ancient symbol of perfection, purity, and love—drive a forty million dollar cut-flower business worldwide? What has been gained (and lost) in tinkering with Mother Nature? Should we care if (and why) some roses have lost their scent? Should we be concerned that most flowers are sprayed with pesticides? In a global marketplace, is there such a thing as a socially responsible flower?

Stewart has a meticulously researched writing style that informs but also humorously captivates while covering the subjects of botany, history, and commerce. She travels the globe seeing firsthand how flowers are grown and harvested on farms in Latin America, California, and Holland (which isn't always pretty). She learns about the eccentric American breeder Leslie Woodruff who developed the popular 'Star-Gazer' lily; a breeder of gerberas of every color imaginable; and an Ecuadorian farmer growing exquisite, high-end organic roses that are the floral equivalent of a Tiffany diamond.

> "Breeding the perfect flower is a balancing act, a compromise between longevity and scent, color and shape, between what the geneticist can imagine and what the flower will allow."

Go with Stewart to Amsterdam to the famous Aalsmeer flower auction known around the world as a remarkably high-tech, high-speed way to sell flowers. This is the very center of the flower trade where a full 20 percent of the cut flowers in the world are sold and about half of the world's cut-flower supplies move through the Dutch auction system. Follow her to Miami airport where millions of flowers enter the United States and are processed.

Learn how the Dutch are spearheading certification programs to make all flowers safe for the consumer and the laborers who help grow them; how Latin America and the United States are also beginning such 'green' programs; how the public can be ecologically aware consumers and where to find organically grown cut flowers.

There are appendices on: The Care and Feeding of Cut Flowers, Visiting Markets and Growers (a list of markets, festivals, and tourist attractions to reference for a behind-the-scenes look at the cut flower industry), and Statistics (Table 1: Worldwide per capita cut flower consumption; Table 2: Top ten cut flowers, United States, per 1,000 stems; Table 3: U.S. cut flower imports by country of origin; Table 4: U.S. cut flower purchases: Market share of outlet).

Complimenting the author's talent of combining the 'literary' contrast of the romance of flowers with the hard bottom line of commerce, illustrator Emma Skurnick's black and white, pen and ink, diagrammatical botanical illustrations are worth mentioning. These are very informative as well as having an elegance of line that reflects the nature of the flower.—*Linny Heagy, Linny/Designer, Illustrator, email: a0005835@airmail.net.*

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CINCO NUEVAS ESPECIES DE *PILEA* (URTICACEAE) DE COSTA RICA

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RESUMEN

Cinco especies nuevas de *Pilea*, endémicas de Costa Rica, son descritas e ilustradas: **Pilea alfaroana** Al. Rodr. & A.K. Monro, **P. gamboana** Al. Rodr. & A.K. Monro, **P. herrerae** Al. Rodr. & A.K. Monro, **P. longibracteolata** Al. Rodr., A.K. Monro & L. Acosta, **P. moragana** Al. Rodr. & A.K. Monro, además se comentan sus afinidades dentro del género y su ubicación bajo las clasificaciones de Weddell y Killip.

ABSTRACT

Five new species of *Pilea*, endemic to Costa Rica, are described and illustrated: **Pilea alfaroana** Al. Rodr. & A.K. Monro, **P. gamboana** Al. Rodr. & A.K. Monro, **P. herrerae** Al. Rodr. & A.K. Monro, **P. longibracteolata** Al. Rodr., A.K. Monro & L. Acosta, **P. moragana** Al. Rodr. & A.K. Monro. Their affinities are discussed and their position within Weddell's and Killip's subdivisions of the genus are indicated.

Pilea Lindl. es un género con alrededor de 715 especies (Monro 2004) por el mundo, de las cuales cerca de 36 están presentes en Costa Rica. Es un género pantropical (con la excepción de Australia) con su centro de diversificación filogenético y morfológico en Asia del Sur y con un número de especies en América del Sur y Las Antillas Mayores (Monro 2006). En los Neotrópicos, *Pilea* se distingue de otros géneros de la familia Urticaceae por la presencia de hojas opuestas y estípulas intrapeciolares, la ausencia de tricomas urticantes, el hábito terrestre, epífito o epilítico, el periantio de las flores femeninas con 3 lóbulos desiguales y libres y por la presencia de apéndices subapicales sobre los tépalos masculinos (éstos a veces ausentes, e.g., en *P. longibracteolata* Al. Rodr., A.K. Monro & L. Acosta); además las especies de *Pilea* son generalmente hierbas con tallos suculentos que pueden parecer a especies de *Begonia*.

En Costa Rica y Panamá este género ha sido poco estudiado taxonómicamente. Entre las principales contribuciones encontramos las de Standley (1937) en *Flora of Costa Rica*, Burger (1977) en *Flora Costaricensis* y Killip (1960) en *Flora of Panama*. En la región Mesoamericana otros aportes importantes son la *Flora of Guatemala* (Standley & Steyermark 1952), la sinopsis de *Mesoamerica* por Monro (2001) y la revisión por *Flora Mesoamericana* (Davidse et al. 1994) hecho por Monro (in prep).

Nuevas exploraciones en Costa Rica han resultado en la descripción de las siguientes cinco especies nuevas.

Pilea alfaroana Al. Rodr. & A.K. Monro, sp. nov. (**Fig. 1**). Tipo: COSTA RICA. San José: Pérez Zeledón, Parque Nacional Chirripó, cuenca Térraba-Sierpe, sendero Llano Bonito, 09°27'24"N, 83°32'47"W, 2450 m, 4 May 1997, *E. Alfaro, B. Gamboa, R. Aguilar & A. Picado 1200* (holotipo: INB).

Species *P. pubescenti* Liebm. affinis, sed ab ea stipulis majoribus et inflorescentiis unisexualibus differt.

Hierba erecta o procumbente, 0.25–0.35 m de altura, terrestre, dioica o monoica; tallos subteretes, ligeramente acostillados, suculentos, densamente pubescentes, los tricomas 0.75–1.00 mm, simples, erectos, rectos o curvados, con esparcidas glándulas rojizas y sésiles, los cistolitos fusiformes. Estípulas 7–14 mm de largo y 1.0–1.2 mm de ancho, obovadas u ovadas a ovado-orbiculares, subcordadas en la base, obtusas en el ápice, varias veces nervadas a inconspicuamente nervadas, persistentes, adpresas, ascendentes o divaricadas, glabras; hojas del mismo nudo subiguales en tamaño; pecíolos 5–8 mm de largo, subiguales a levemente desiguales, con una relación en tamaño de 1: 1.0–1.7, esparcidamente pubescentes, los tricomas 0.75–1.00 mm, simples, erectos o aplanados, rectos o curvados, con esparcidas glándulas rojizas y sési-

J. Bot. Res. Inst. Texas 2(2): 995 – 1007. 2008

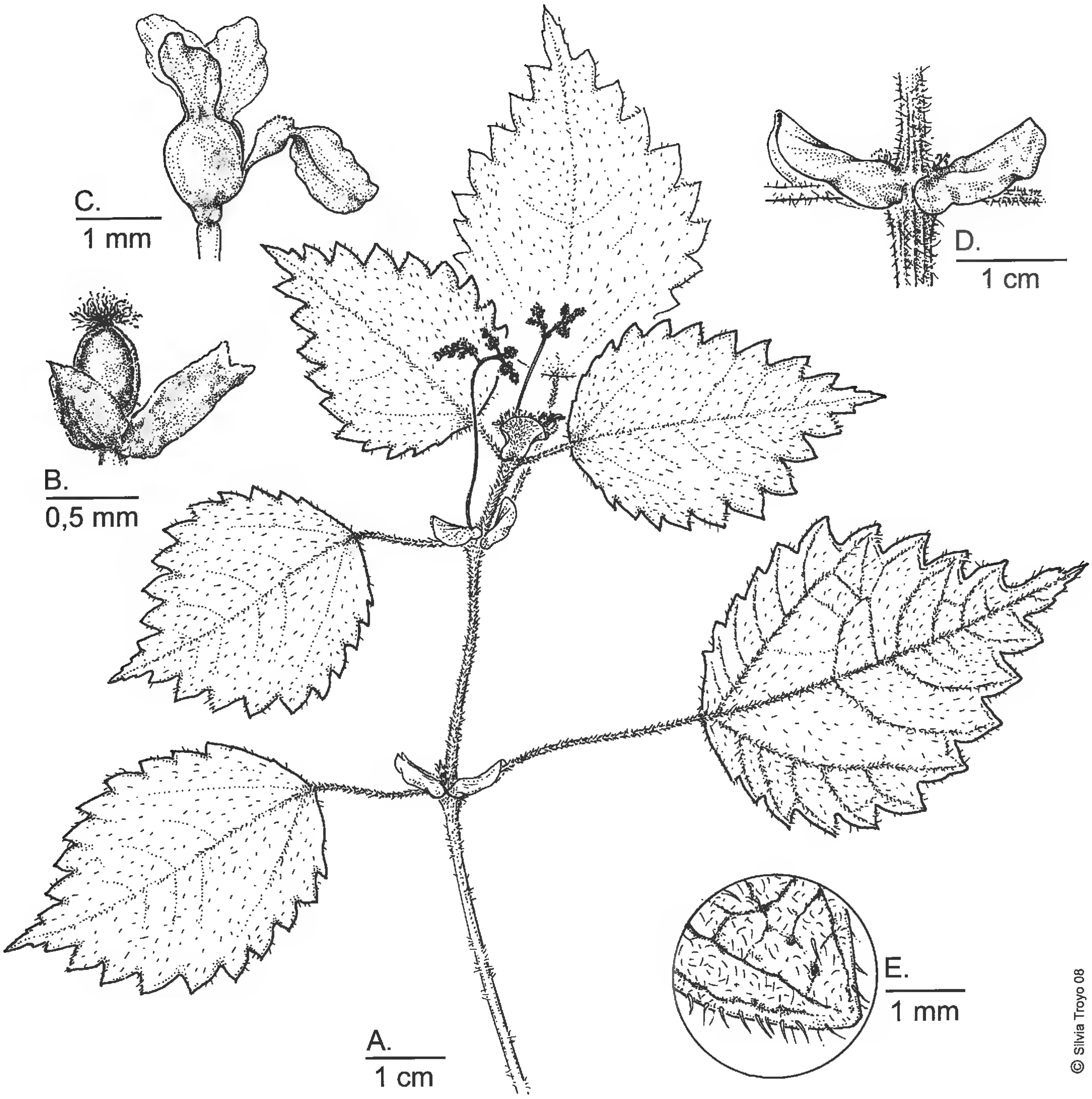

Fig. 1. A–E. *P. alfaroana* Al. Rodr. & A.K. Monro. A. Hábito; B. Flor femenina; C. Flor masculina; D. Estípulas; E. Cistolitos y pubescencia en el envés de las hojas. A, C, D, E, basados en *J. González 1918* (INB); B, basado en *D. Santamaría 4072* (INB).

les; lámina 7–90 mm de largo y 6–85 mm de ancho, ovada a ovado-orbicular; base obtusa a cortamente cuneada; ápice agudo; margen gruesamente dentado; nervadura palmada o subpalmada, con 3 a 5 nervios saliendo desde la base o hasta 4 mm sobre la misma; haz densamente pubescente, los tricomas 0.5–1.5 mm, simples, aplanados, rectos o curvados, glabrescente con la edad, con esparcidas glándulas rojizas y sésiles, los cistolitos fusiformes o en forma de "V," secando verde a verde-grisáceo; envés esparcida a densamente pubescente, los tricomas 1.00–1.75 mm, simples, erectos o aplanados, rectos o curvados, con esparcidas glándulas rojizas y sésiles, los cistolitos fusiformes o en forma de "V," verde-pálido al secar. Inflorescencias unisexuales, axilares, 1 por axila, presentes en los nudos terminales, dimorfas; inflorescencias masculinas 15–40 mm de largo y 5–12 mm de ancho, cimas capitadas y simples o poco y cortamente ramificadas, el pedúnculo 15–25 mm de largo, densamente pubescente, los tricomas 0.75–1.00 mm, simples, erectos, rectos o curvados, con esparcidas glándulas rojizas y sésiles, basalmente con brácteas pedunculares 1.00–2.25 de la largo y 0.75–1.25 mm de ancho, ovadas, basalmente glabras, hialinas, generalmente difíciles de observar; flores masculinas en glomérulos, subsésiles o con pedicelos hasta 1.7 mm de largo y glabrescentes, bracteolas pedicelares 0.75–2.00 mm de largo y 0.20–0.75 mm de ancho, lanceoladas a oblongo-lanceoladas, glabras, hialinas; inflorescencias femeninas 10–40 mm de largo y 5–25 mm de ancho, cimas simples o varias veces ramificadas, el pedúnculo 10–30 mm de largo, glabrescente o con esparcidos tricomas ca. 2.5 mm de largo, simples, erectos, rectos o curvados; flores femeninas distribuidas a lo largo del raquis de la inflorescencia, subsésiles o con pedicelos hasta 0.5 mm de largo y glabros, bracteolas pedicelares 0.5–0.6 mm de largo y 0.2–0.6 mm de ancho, lanceoladas, glabras, hialinas. Flores masculinas con periantio 0.75–1.50 mm de largo, glabro o esparcidamente pubescente, los tricomas 0.3–0.5 mm, simples, erectos, rectos, 4-lobulado, los lóbulos 0.5–1.1 mm de largo, lanceolados a obovados, incisos 1/4–3/4 de la longitud del periantio, los apéndices subapicales 0.70–1.50 mm de largo; estambres 4, los filamentos 1.3–2.0 mm de largo, las anteras ca. 0.5 mm de largo y 0.35 mm de ancho; pistiloide muy pequeño y apenas distinguible; flores femeninas con lóbulos del periantio levemente desiguales, el dorsal ca. 0.7 mm de largo; estaminodios 3; estigma diminuto, penicilado, erecto. Aquenios 0.75–1.00 mm de largo (incluyendo el estigma) y ca. 0.75 mm de ancho, ovoides, subcompresos, simétricos, verdes a verde-castaños, con una línea submarginal puncticulada.

Fenología.—Flores y frutos entre abril, mayo y junio.

Distribución y Hábitats.—Endémica de Costa Rica. Se conoce de los bosques pluviales de la vertiente Pacífica en la cordillera de Talamanca, en Copey de Dota, en Llano Bonito del Parque Nacional Chirripó y en Tres Colinas de Potrero Grande, 1500–2450 m. Esta especie es conocida de pocas localidades y se ha observado creciendo entre robledales, principalmente a orillas de quebradas donde podría formar parches densos.

Discusión.—*Pilea alfaroana,* según la clasificación de Weddell (1869), pertenece al grupo *Dentatae* y según la clasificación de Killip (1960) al grupo *Molles.* Se reconoce por ser una hierba terrestre, en general procumbente, con partes vegetativas densamente pubescentes, hojas isófilas, margen gruesamente dentado, estípulas conspicuas, hialinas, persistentes, obovadas u ovadas a ovado-orbiculares, cordadas en la base, obtusas en ápice, por sus flores masculinas con periantio generalmente pubescente, por sus frutos con una línea submarginal puncticulada y por presentar una distribución muy localizada.

En apariencia vegetativa es similar a *P. pubescens* Liebm. considerando que ambas especies poseen un hábito regularmente procumbente y terrestre, pubescencia densa y hojas isófilas, ovadas a ovado-orbicular y dentadas. Se distinguen así:

1. Estípulas 2–5 mm de largo, haz de la hoja pubescente, los tricomas 2–3 mm, inflorescencias bisexuales, 10–120 mm, distribuido entre 100–200 msnm ________ **Pilea pubescens**
1. Estipulas 7–14 mm, haz de la hoja densamente pubescente, los tricomas 0.5–1.5 mm, inflorescencias unisexuales, 15–40 mm, distribuido entre 1500–2450 msnm ________ **Pilea alfaroana**

Etimología.—Esta especie es nombrada en honor a Evelio Alfaro, un excelente y animoso parataxónomo que aportó la colección Tipo de esta especie y trabajó en el INBio entre los años de 1995 y 2003, donde hizo una colección con más de 5500 especimenes botánicos, entre otros logros significativos. Lastimosamente en la actualidad se mantiene alejado de la actividad botánica, se estableció en Estados Unidos procurando mejorar su condición económica.

Material examinado. **COSTA RICA. Puntarenas:** Buenos Aires, Potrero Grande, Tres Colinas, 09°06'17"N, 83°03'54"W, 1500 m, 25 Abr 2006, *D. Santamaría 4072* (INB). **San José:** Pérez Zeledón, Reserva Forestal Los Santos, cuenca del Savegre, San Gerardo de Dota, sendero Los Robles, 09°32'50"N, 83°49'00"W, 2200–2350 m, 22 May 1197, *J. González & M. Zumbado 1918* (INB); Dota, Copey, Área no Protegida, San Gerardo, sendero La Quebrada, 09°23'10"N, 83°48'23"W, 2300 m, 5 Jun 2002, *A. Quesada 1017* (CR); Rivas, Parque Nacional Chirripó, sector Llano Bonito, alrededores de la casa, bosques de robledales, 09°27'34"N, 83°32'47"W, 2450 m, 30 Ago 2000, *A. Rodríguez 6383* (INB).

Pilea gamboana Al. Rodr. & A.K. Monro, sp. nov. (**Fig. 2**). Tipo: COSTA RICA: San José: Pérez Zeledón, Cuenca Térraba-Sierpe, Puesto Tres Colinas, colectado a orillas del río Guineo, bosque primario, 09°07'27"N 83°04'29"W, 1700 m, 17 Set 1996, *B. Gamboa & A. Picado 639* (holotipo: INB; isotipo: MO).

Species *P. pittieri* Killip affinis, sed ab ea foliis subpeltatis et inflorescentiis staminalibus paniculatis differt.

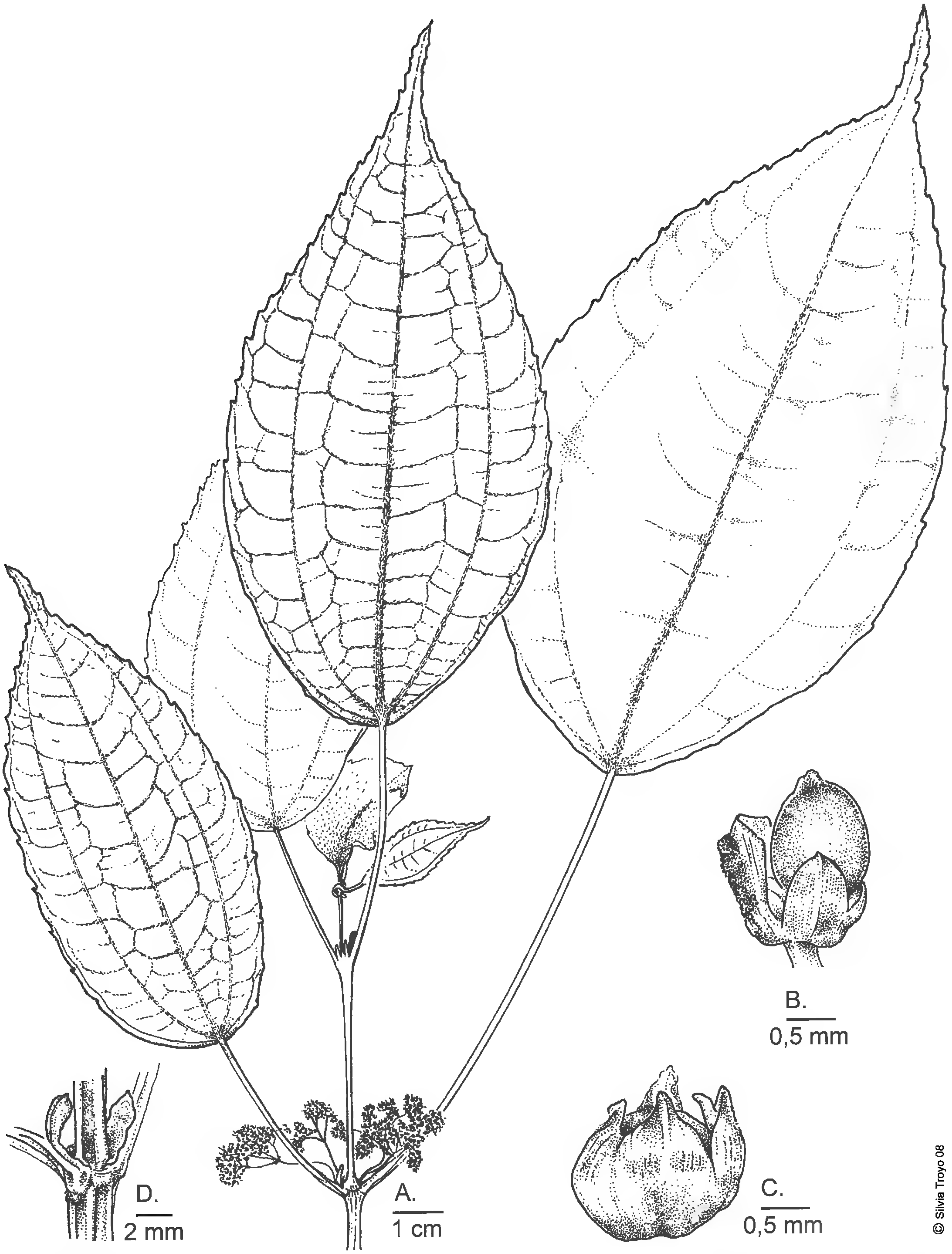
B.
0,5 mm
C.
0,5 mm
D.
2 mm
A.
1 cm
© Silvia Troyo 08

Fig. 2. A–D. *P. gamboana* Al. Rodr. & A.K. Monro. A. Hábito; B. Flor femenina; C. Flor masculina; D. Estípulas. A, D, basados en *B. Gamboa 639* (INB); B, C, basado en *G. Herrera 3509* (INB).

Hierba erecta o procumbente, 0.3–0.5 m de altura, terrestre o epilítica, dioica o monoica; tallos subteretes, glabros, con esparcidas glándulas rojizas y sésiles, los cistolitos fusiformes. Estípulas 3–4 mm de largo y 1.0–1.5 mm de ancho, oblongas a oblongo-obovadas, agudas a obtusas en el ápice, con nervadura inconspicua, decíduas o persistentes en los nudos terminales, ascendentes, glabras; hojas del mismo nudo subiguales, con una relación en tamaño de 1: 1–3 (incluyendo el pecíolo); pecíolos 4–100 mm de largo, subiguales o desiguales, con una relación en tamaño de 1: 1.3–3.0, glabros, ocasionalmente con esparcidas glándulas rojizas y sésiles; lámina 10–150 mm de largo y 4–75 mm de ancho, ovada o elíptica a ovado-elíptica; base subpeltada a peltada; ápice acuminado; margen cortamente dentado o denticulado; nervadura palmada o subpalmada, con 3 ó 5 nervios evidentes saliendo desde la base o hasta 2 mm sobre la misma; haz y envés glabrescentes, los cistolitos fusiformes o en forma de "V" sobre ambas superficies, secando verde-grisáceos, verde-pajizos o rojizos. Inflorescencias unisexuales, axilares, 1 ó 2 por axila, subiguales; inflorescencias masculinas 10–45 mm de largo y 10–30 mm de ancho, cimas paniculadas, el pedúnculo 10–25 mm de largo, glabro, basalmente con brácteas pedunculares 0.75–1.50 mm de largo y ca. 1.0 mm de ancho, deltoides, glabras; flores masculinas con pedicelos 0.30–0.75 mm de largo, glabros, bracteolas pedicelares 0.30–0.75 mm de largo y 0.25–0.40 mm de ancho, carentes de nervios evidentes, glabras; inflorescencias femeninas 10–40 mm de largo y 5–40 mm de ancho, cimas varias veces ramificadas, el pedúnculo 4–20 mm de largo, glabro, basalmente con brácteas pedunculares 0.50–0.75 de la largo y 0.50–0.60 mm de ancho, deltoides; flores femeninas subsésiles o pedicelos hasta 1 mm de largo, glabros, bracteolas pedicelares 0.30–0.75 mm de largo y 0.25–0.40 mm de ancho, carentes de nervios evidentes, glabras. Flores masculinas con periantio 1.00–1.25 mm de largo, glabro, 4-lobulado, los lóbulos 0.75–1.00 mm de largo, oblongos a oblongo-lanceolados, incisos ca. 3/4 de la longitud del periantio, los apéndices subapicales 0.10–0.25 mm de largo; estambres 4, los filamentos 1.00–1.25 mm de largo, las anteras 0.4–0.5 mm de largo y 0.3–0.4 mm de ancho; pistiloide muy reducido; flores femeninas con lóbulos del periantio levemente desiguales, el dorsal 0.50–0.75 mm de largo, los laterales 0.3–0.4 mm de largo; estaminodios 3, ca. 0.12 mm de largo y de ancho, petaloides; estigma inconspicuamente penicilado, erecto. Aquenios 0.75–1.00 mm de largo (incluyendo el estigma) y 0.60–0.75 mm de ancho, ovoides a elipsoides, subcompresos, simétricos a levemente asimétricos, café-pajizos, lisos.

Fenología.—Poco conocida, hasta el momento flores y frutos sólamente observados en septiembre y octubre.

Distribución y Hábitats.—Endémica de Costa Rica. Se conoce en los bosques pluviales de la vertiente Pacífica en la Cordillera de Talamanca, 1450–1750 m. La especie se ha observado creciendo principalmente a orilla de ríos y quebradas.

Discusión.—*Pilea gamboana,* según la clasificación de Weddell (1869), pertenece al grupo *Dentatae* y según la clasificación de Killip (1960) al grupo *Molles*. Se reconoce por el hábito terrestre o epilítico, por sus hojas con la base subpeltada, las del mismo nudo subiguales, con el margen levemente dentado, las estípulas pequeñas, tempranamente deciduas, por las flores masculinas y femeninas en cimas paniculadas y por su localizada distribución.

Vegetativamente es similar a *Pilea pittieri* Killip, una especie igualmente endémica de Costa Rica, debido a que ambas son plantas glabrescentes, por el tamaño y forma de las estípulas, por sus hojas subiguales y lámina con frecuencia ovada. Sin embargo, se puede distinguir por los carácteres siguientes:

1. Hojas basifijas, flores masculinas dispuestas en cimas capitadas, el periantio con apéndices subapicales 0.5–2.0 mm ________ **Pilea pittieri**
1. Hojas subpeltadas, flores masculinas dispuestas en cimas paniculadas, el periantio con apéndices subapicales 0.10–0.25 mm ________ **Pilea gamboana**

Etimología.—Esta especie es nombrada en reconocimiento de Billen Gamboa, un excelente parataxónomo del INBio que ha recolectado ampliamente en Costa Rica, principalmente en la cordillera de Talamanca.

Material examinado. **COSTA RICA. Puntarenas:** Buenos Aires, Reserva Indígena Ujarrás, cordillera de Talamanca, Reserva Biológica Dúrika, 09°16'30"N 83°14'40"W, 1500 m, 6 Set 1995, *R. Aguilar et al. 4295* (CR, INB); Ujarrás, cabeceras del río Kuiyé, siguiendo las Filas que dan a Olán, 09°17'50"N 83°14'45"W, 1450 m, 20 Set 1989, *G. Herrera 3509* (INB, MO). **San José:** Pérez Zeledón, cuenca Térraba-Sierpe, casi km 116 a la par de la carretera, cuenca del río Quebradas, 09°28'40"N, 83°41'25"W, 1750 m, 7 Oct 1997, *B. Hammel 21094 & H. Kennedy 21094* (INB, CR, MO, BM).

Pilea herrerae Al. Rodr. & A.K. Monro, sp. nov. (**Fig. 3**). Tipo: COSTA RICA: Limón: Cantón de Guápiles, Los Angeles, San Miguel, siguiendo el camino al Volcán Irazú, cuenca media del río Blanquito, margen izquierdo, 10°06'50"N, 83°49'30"W, 1100 m, 26 Feb 1990, *G. Herrera 3851* (holotipo: INB; isotipo: CR).

Species *P. costaricensi* Donn. Sm. affinis, sed ab ea inflorescentiis capitatis, floribus staminalibus majoribus et lobulo dorsali florium pistillatorum majore differt.

Hierba erecta o procumbente, 0.4–1.0 m de altura, terrestre, dioica o monoica; tallos subteretes, suculentos, glabrescentes, con esparcidas glándulas rojizas y sésiles, los cistolitos escasos, punticulados o cortamente fusiformes. Estípulas 1–2 mm de largo y 0.50–0.75 mm de ancho, lanceoladas, agudas en el ápice, la nervadura inconspicua, persistentes, ascendentes, glabras; hojas del mismo nudo anisófilas, con una relación en tamaño de 1: 1.6–23.0 (incluyendo el pecíolo); hojas menores en ocasiones ausentes, subsésiles o con pecíolos hasta 3 mm de largo, glabros, la lámina 3–17 mm de largo y 5–10 mm de ancho, linear-lanceolada o elíptica; hojas mayores con pecíolos 5–15 mm de largo, glabros, con esparcidas glándulas rojizas sésiles, la lámina 30–190 mm de largo y 10–55 mm de ancho, lanceolada, elíptico-oblanceolada o falcado-lanceolada; base obtusa, levemente oblicua o a menudo subpeltada; ápice acuminado; margen entero a raras veces denticulado; nervadura 3-plinervada a subpalmada, con 3 nervios evidentes saliendo 2–4 mm sobre la base; haz y envés glabrescentes, a menudo con esparcidas glándulas rojizas y sésiles, los cistolitos fusiformes o en forma de "V," secando gris, gris-oscuros o verde-grisáceos. Inflorescencias unisexuales, axilares, 1 ó 2 por axila, monomorfas a ligeramente dimorfas; inflorescencias masculinas 5–50 mm de largo y 5–12 mm de ancho, cimas capitadas, raras ocasiones cimas 2 ó 3 veces cortamente ramificadas, el pedúnculo 2–45 mm de largo, glabro, en ocasiones con esparcidas glándulas rojizas y sésiles, basalmente con brácteas pedunculares 0.3–0.5 mm de la largo y 0.3–0.5 mm de ancho, ovadas, glabras; flores masculinas subsésiles o con pedicelos hasta 1.75 mm de largo, glabros, con esparcidas glándulas rojizas y sésiles, bracteolas pedicelares 0.5–1.0 mm de largo y 0.25–1.00 mm de ancho, lanceoladas, glabras; inflorescencias femeninas en plantas monoicas ubicadas en los nudos inferiores, 10–30 mm de largo y 5–12 mm de ancho, el pedúnculo 5–26 mm de largo, glabro; flores femeninas subsésiles o pedicelos hasta 2 mm de largo, glabros, bracteolas pedicelares 0.3–0.5 mm de largo y 0.5–0.7 mm de ancho, lanceoladas, glabras. Flores masculinas con periantio 1.50–2.25 mm de largo, glabro, 4-lobulado, los lóbulos 0.75–1.00 mm de largo, incisos ca. 3/4 de la longitud del periantio, los apéndices subapicales 0.50–0.75 mm de largo; estambres 4, los filamentos 1.25–1.50 mm de largo, las anteras ca. 1.25 mm de largo y 0.75 mm de ancho; pistiloide reducido; flores femeninas con lóbulos del periantio levemente desiguales, el dorsal 1.5–3.0 mm de largo, los laterales 1.25–1.50 mm de largo; estaminodios 3, ca. 0.75 mm de largo y 0.7 mm de ancho, petaloides; estigma diminuto, penicilado, erecto. Aquenios 2.0–2.5 mm de largo (incluyendo el estigma) y 0.25–1.75 mm de ancho, ovados, subcompresos, simétricos, café, lisos.

Fenología.—Flores y frutos en enero, febrero, marzo y abril, además en agosto, septiembre y noviembre.

Distribución y Hábitats.—Endémica de Costa Rica. Se conoce de los bosques húmedos y pluviales de la vertiente Caribe en la cordillera de Talamanca, 700–1700 m.

Discusión.—*Pilea herrerae*, según la clasificación de Weddell (1869), pertenece al grupo *Heterophyllae* y según la clasificación de Killip (1960) al grupo *Centradenoideae*. Se reconoce por ser terrestre y con hojas del mismo nudo conspicuamente anisófilas, el margen generalmente entero, la nervadura 3-plinervada a subpalmada, en ocasiones las hojas más largas subpeltadas (difícil de notar en especímenes), por sus estípulas diminutas y por presentar flores en cimas capitadas, no ramificadas.

Esta especie es muy similar a *Pilea costaricensis* Donn. Sm., la cual también presenta hojas del mismo nudo anisófilas y el margen de la lámina entero a levemente dentado. Se puede distinguir por los carácteres siguientes:

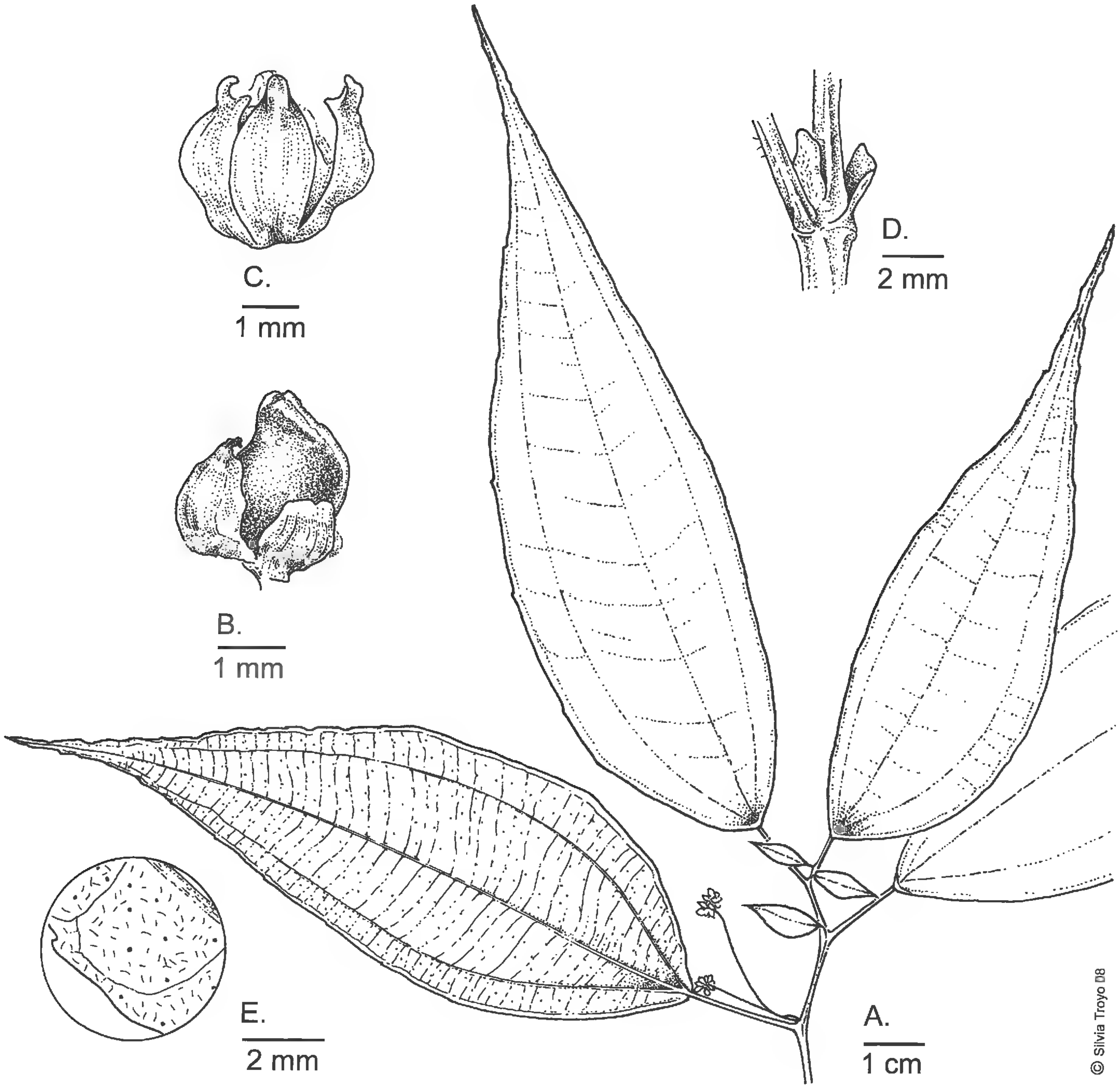

Fig. 3. A–E. P. herrerae Al. Rodr. & A.K. Monro. A. Hábito; B. Flor femenina; C. Flor masculina; D. Estípulas; E. Cistolitos en el envés de las hojas. A, D, E, basados en J. Bittner 1456 (INB); B, C, basados en A. Rodríguez 11066 (INB).

1. Inflorescencias masculinas y femeninas cimas ramificadas, 5–10 mm de largo, flores masculinas con un periantio de 1.00–1.25 mm, flores femeninas con el lóbulo dorsal 1.0–1.5 mm, aquenio 0.5–1.0 mm de largo, pecíolos de las hojas mayores 9–45 mm ________ **Pilea costaricensis**
1. Inflorescencias masculinas y femeninas generalmente cimas capitadas, 5–50 mm de largo, flores masculinas con un periantio de 1.50–2.25 mm, flores femeninas con el lóbulo dorsal 1.5–3.0 mm, aquenio 2.0–2.5 mm de largo, pecíolos de las hojas mayores 5–15 mm ________ **Pilea herrerae**

El tipo era erróneamente identificado como *P. purulensis* por Monro en 1999.

Etimología.—Gerardo Herrera, un botánico costarricense contemporáneo, es, sin la menor duda, uno de los mejores recolectores. Su esfuerzo en colecta de plantas ha concluido en múltiples novedades para la ciencia, incluyendo ésta, por tal razón dedicarle esta especie es un reconocimiento a su valioso esfuerzo.

Material examinado. **COSTA RICA. Cartago:** Jiménez, Pejibaye, Refugio de Vida Silvestre La Marta, 09°47'15"N 83°43'30"W, 700–800 m, 29 Set 2004, *R. Kriebel & A. Soto 4877* (INB); Selva, Reserva Biológica El Copal, 09°47'10"N 83°45'06"W, 1100–1200 m, 30 Ene 2008, *G. Wood & D. Wood 8058* (INB); Turrialba, Parque Nacional Barbilla, cuenca del Matina, Sendero Barthon, Punta Fría, Sección Corina-Cerro Tigre, 09°55'15"N 83°23'55"W, 1600 m, 6 Mar 2001, E. *Mora et al. 1835* (CR). **Limón:** Talamanca, Camp by Kivut, trail between Kivut and Alto Lari, 1–2 km up to Alto Lari, primary forest, 1–2 km up to Alto Lari, primary forest, 09°24'15"N 83°05'05"W, 1100–1200 m, 7 Mar 1992, *J. Bittner 1456* (INB, MO); entre cerro Chimú y cerro Matama, 1200 m, 29 Abr 1995, *L. D. Gómez & G. Herrera 23540* (CR); cordillera de Talamanca, N flank of Fila de Matama in headwaters of río Boyei, 09°45'N, 83°19'W, 1200–1300 m, 18 Ago 1995, *M. Grayum 11085* (INB); Bratsi, Parque Internacional La Amistad, Sendero Transtalamanca, alrededores de quebrada Lari, tributario del Coén, 09°25'40"N 83°11'59"W, 1600–1700 m, 6 Feb 2007, *A. Rodríguez et al. 11066* (INB); Bratsi, Reserva Indígena Bribri, 1.7 km southwest of Kivut, 6.1 km southwest of Alto Lari, in primary forest with heavy epiphyte density, 09°23'45"N 83°05'40"W, 1500–1530 m, 27 Feb 1992, *H. Schmidt et al. 623* (INB); Valle de la Estrella, Fila Matama, cerca de 11 km SW del pueblo de Aguas Zarcas, bosque maduro dominado por *Tetragastris panamensis, Calatola costaricensis, Quaribaea, Sloanea* y *Billia rosea*, 09°49'04"N 83°09'31"W, 800–900 m, 1 Nov 2007, *D. Solano 4870* (INB)

Pilea longibracteolata Al. Rodr., A.K. Monro & L. Acosta, sp. nov. (**Fig. 4**). TIPO: COSTA RICA. CARTAGO: Paraíso, Parque Nacional Tapantí-Macizo de la Muerte, cuenca del Reventazón, Sector del Túnel, 09°42'10"N, 83°47'20"W, 1700 m, 8 Mar 2000, *L. Acosta & L.D. Vargas 3200* (HOLOTIPO: INB; ISOTIPOS: CR, MO).

Species bracteis magnis inflorescentiae staminalis a congeneribus diversa.

Hierba erecta o subarbusto, 0.5–1.0 m de altura, terrestre o epipétrica, dioica o monoica; tallos subteretes a levemente 5-acostillados, suculentos, glabrescentes a densamente ferrugíneo-pubescentes en las ramitas terminales, los tricomas 0.40–1.75 mm, simples, multicelulares, adpresos, torcidos, con esparcidas glándulas rojizas y sésiles, los cistolitos ausentes o al menos no evidentes. Estípulas 6–15 mm de largo y 10–12 mm de ancho, ovado-lanceoladas, sagitadas en la base, agudas y bífidas en el ápice, con nervadura inconspicua, persistentes, ascendentes, glabrescentes, las del mismo nudo unidas basalmente y rodeando el tallo (visibles en nudos terminales), en nudos inferiores cada una partiéndose hasta la mitad longitudinalmente, formando en cada lado 2 aparentes estípulas interpeciolares basalmente unidas; hojas del mismo nudo isófilas; pecíolos 0.3–13.0 cm de largo, subiguales a desiguales, con una relación en tamaño de 1: 1.2–6.5, glabrescentes a esparcida o densamente ferrugíneo-pubescentes en ramitas terminales, los tricomas 0.50–1.75 mm, simples, adpresos, torcidos, con esparcidas glándulas rojizas y sésiles; lámina 2.5–23.0 cm de largo y 0.5–14.0 cm de ancho, ovada a ovado-elíptica; base obtusa o subcordada a cortamente cuneadas; ápice acuminado; margen dentado; nervadura palmada o subpalmada, con 3 nervios evidentes saliendo desde la base o hasta 4 mm sobre la misma; haz glabrescente, los cistolitos fusiformes o en forma de "V," levemente bullado (no o apenas distinguible en material seco), secando castaño, castaño-rojizo o castaño oscuro; envés esparcidamente pubescente sobre los nervios principales, densamente pubescente en hojas nuevas, los tricomas 0.50–1.75 mm, simples, adpresos, torcidos, con esparcidas glándulas rojizas y sésiles, los cistolitos fusiformes. Inflorescencias unisexuales, axilares, 1 ó 2 por axila, dimorfas; inflorescencias masculinas 10–40 mm de largo y 10–30 mm de ancho, cimas unilaterales, poco o no ramificadas, con flores prontamente caedizas, subsésiles o con pedúnculo hasta 14 mm de largo, glabro, basalmente con brácteas pedunculares 5–7 mm de largo y 1.0–1.5 mm de ancho, oblongas a oblongo-lanceoladas, esparcidamente pubescentes, los tricomas ca. 0.75 mm, simples, adpresos, torcidos; flores masculinas subsésiles o con pedicelo hasta 5 mm de largo, glabro, bracteolas pedicelares conspicuas, 5–12 mm de largo y 2–7 mm de ancho, ovadas o lanceoladas a oblongas, con 3 a 10 nervios paralelos, esparcidamente pubescentes, al menos en el lado externo, los tricomas 0.2–0.5 mm, simples, adpresos, torcidos; inflorescencias femeninas ubicadas en nudos inferiores o entremezcladas con las masculinas, 10–70 mm de largo y 10–40 mm de ancho, cimas poco a varias veces ramificadas, el pedúnculo 5–40 mm de largo, glabrescente, basalmente con brácteas pedunculares 2.5–3.0 mm de largo y 0.75–1.00 mm de ancho, oblongas a oblongo-obovadas, glabrescentes; flores femeninas subsésiles o con pedicelos hasta 0.5 mm de largo, glabro, bracteolas pedicelares 0.75–2.50 mm de largo y 0.2–1.3 mm de ancho, lanceoladas a oblongo-lanceoladas, uninervada o con 3 nervios paralelos, glabras. Flores masculinas con periantio 1.5–2.0 mm de largo, glabro, 4-lobulado, los lóbulos 1.0–1.5 mm de largo, oblongos a oblongo-lanceolados, incisos ca. 3/4 de la longitud del perianto, los apéndices subapicales ausentes o si presentes no más de 0.25 mm de largo; estambres 4, los filamentos 1.5–2.0 mm de largo, las anteras 0.60–0.75 mm de largo y 0.5–6.0 mm de ancho; pistiloide muy pequeño y apenas distinguible; flores femeninas con lóbulos del periantio levemente desiguales, el dorsal 0.75–1.25 mm de largo, los laterales 0.60–0.75 mm de largo;

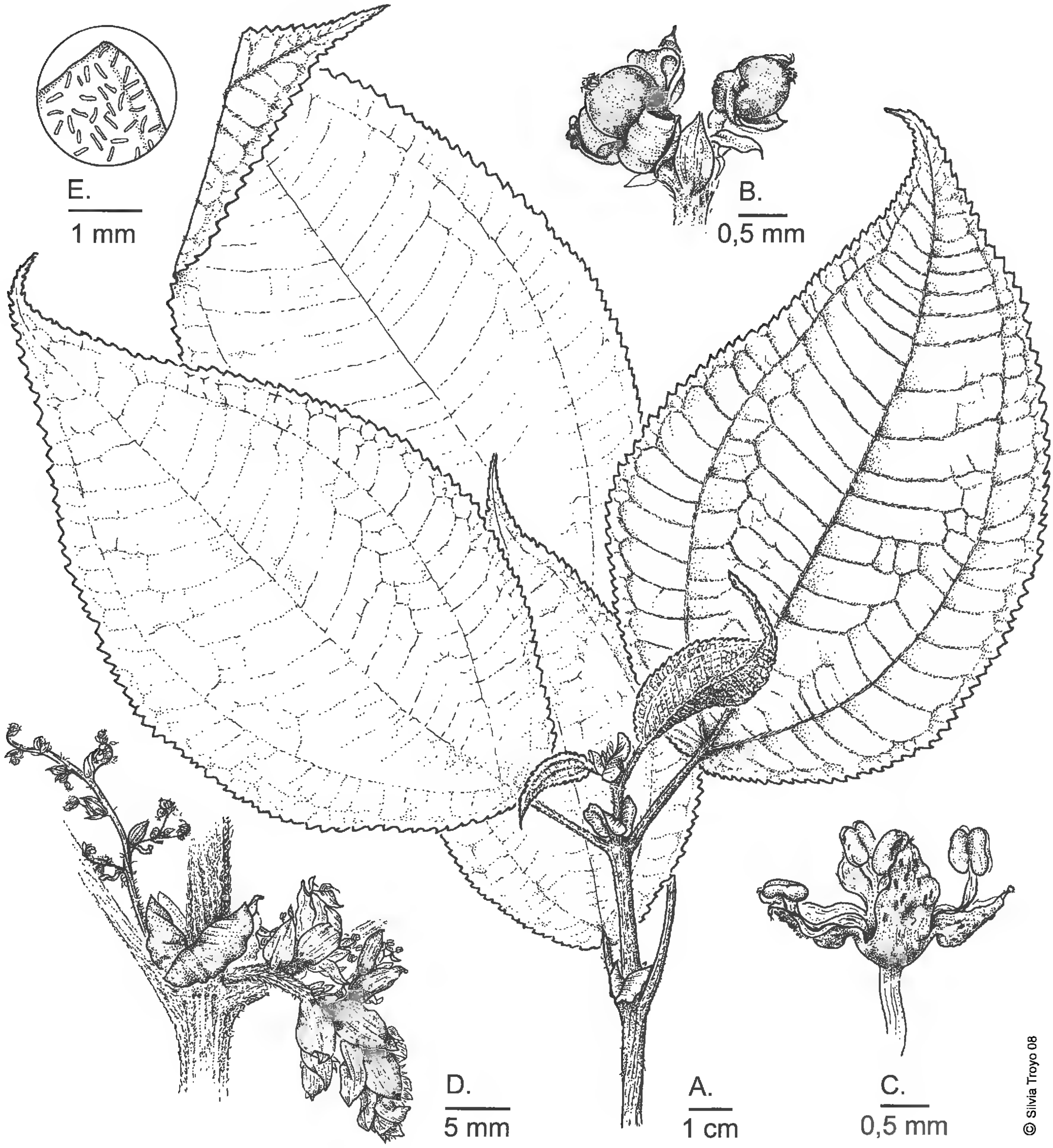

Fig. 4. A–E. *P. longibracteolata* Al. Rodr., A.K. Monro & L. Acosta. A. Hábito; B. Flor femenina;. C. Flor masculina; D. Estípulas, inflorescencia masculina e inflorescencia femenina; E. Cistolitos en el envés de las hojas. A, B, C, D, E, basados en *A. Rodríguez 5877* (INB).

estaminodios 3, ca. 0.12 mm de largo y 0.35 mm de ancho, petaloides; estigma diminuto, penicilado, erecto. Aquenios 0.80–1.25 mm de largo (incluyendo el estigma) y 0.7–0.8 mm de ancho, ovoides, subcompresos, levemente asimétricos, café, lisos, con uno de los márgenes ligeramente engrosado.

Fenología.—Flores y frutos entre marzo y abril y entre noviembre y diciembre.

Distribución y Hábitats.—Endémica de Costa Rica. Se conoce en los bosques pluviales de la vertiente Caribe en la cordillera de Talamanca, en el Parque Nacional Tapantí y en los márgenes del río Coén, 1550–1700 m. Esta especie es conocida únicamente de dos localidades y se ha observado creciendo principalmente sobre paredes rocosas y húmedas dentro del bosque.

Discusión.—*Pilea longibracteolata*, según la clasificación de Weddell (1869), pertenece al grupo *Dentatae* y según la clasificación de Killip (1960) al grupo *Molles*. Se reconoce por presentar estípulas singulares y conspicuas, por su lámina foliar levemente bullada y por la presencia de grandes y evidentes bractéolas en sus inflorescencias masculinas; además la pubescencia ferrugínea (al menos en las ramitas terminales) es característica.

Etimología.—El epíteto latino *longibracteolata* hace alusión a las conspicuas bracteolas pedicelares presentes en las inflorescencias masculinas.

Material examinado. **COSTA RICA. Cartago:** Paraíso, Parque Nacional Tapantí-Macizo de la Muerte, cuenca del Reventazón, colectado a orilla de la calle, desde el cruce del río Humo hasta el túnel, 09°42'10"N, 83°47'20"W, 1700 m, 8 Mar 2000, *L. Acosta & V. Ramírez 578* (CR, INB, MO); alrededores del túnel, 9°43'00"N, 83°47'20"W, 1700 m, 5 Abr 2000, *A. Rodríguez 5877* (INB). **Limón:** Talamanca, Parque Nacional cordillera de Talamanca, 1 km aguas abajo unión quebrada Kirigú y río Coén, 09°23'20"N, 83°12'50"W, 1550 m, 29 Mar 1999, *G. Herrera 6097* (INB, CR).

Pilea moragana Al. Rodr. & A.K. Monro, sp. nov. (**Fig. 5**). Tipo: COSTA RICA. Puntarenas: Golfito, Reserva Forestal Golfo Dulce, Península de Osa, Cerro Rincón, Puerto Jiménez, cabeceras de los ríos Tigre y Rincón, 08°30'50"N 83°28'20"W, 700 m, 7 May 1993, *R. Aguilar 1881* (holotipo: INB; isotipo: CR).

Species *P. acuminatae* Liebm. affinis, sed ab ea stipulis petiolis et inflorescentiis staminalibus capitatis minoribus differt.

Hierba erecta o procumbente, 0.1–0.2 m de altura, aparentemente terrestre, dioica o monoica; tallos subteretes, pubescentes, los tricomas 0.2–0.3 mm, simples, más o menos adpresos, curvados, con inconspicuas y esparcidas glándulas rojizas y sésiles, los cistolitos esparcidos fusiformes. Estípulas 1–3 mm de largo y 0.50–1.25 mm de ancho, ovadas u oblongo-ovadas a oblongo-obovadas, obtusas en el ápice, con nervadura inconspicua, persistentes, ascendentes; hojas del mismo nudo subiguales, con una relación en tamaño de 1: 1.0–2.5 (incluyendo el pecíolo); pecíolos 1–16 mm de largo, subiguales o desiguales, con una relación en tamaño de 1: 1.2–3.4, pubescentes, los tricomas 0.2–0.4 mm, simples, más o menos adpresos, curvados, con inconspicuas y esparcidas glándulas rojizas sésiles; lámina 2–45 mm de largo y 1.5–16.0 mm de ancho, lanceolada a elíptico-lanceolada; base cuneada a levemente oblicua; ápice agudo a cortamente acuminado; margen dentado; nervadura subpalmada o 3-plinervada, con 3 nervios evidentes saliendo 1–2 mm sobre la base; haz glabrescente a esparcidamente pubescente, los tricomas 0.30–0.75 mm, simples, aplanados, curvados, con inconspicuas y esparcidas glándulas rojizas sésiles, los cistolitos escasos, fusiformes o en forma de "V," en ocasiones ausentes, a menudo levemente bullado; envés glabrescente a esparcidamente pubescente sobre los nervios principales, los tricomas 0.25–0.40 mm, simples, aplanados, curvados, con glándulas inconspicuas, esparcidas, rojizas y sésiles, los cistolitos fusiformes o en forma de "V," en ocasiones ausentes. Inflorescencias unisexuales, axilares, solitarias, ligeramente dimorfas; inflorescencias masculinas 5–25 mm de largo y 3–5 mm de ancho, cima capitadas, el pedúnculo 4–22 mm de largo, glabrescente, basalmente con brácteas pedunculares 0.2–0.4 mm de largo y ca. 0.3 mm de ancho, deltoides, glabras; flores masculinas subsésiles o con pedicelos hasta 0.75 mm de largo, glabro, bracteolas pedicelares 0.5–1.0 mm de largo y 0.4–0.5 mm de ancho, lanceoladas, con nervios inconspicuos, café-pajizas; inflorescencias femeninas ca. 15 mm de largo y 3–5 mm de ancho, cimas cortamente ramificadas y pareciendo capitadas, el pedúnculo 3–20 mm de largo, glabro, basalmente con brácteas pedunculares 0.2–0.4 mm de largo y 0.2–0.4 mm de ancho, deltoides, glabras; flores femeninas con pedicelos 0.75–1.00 mm de largo, glabros, bracteolas pedicelares 0.4–0.6 mm de largo y 0.25–0.50 mm de ancho, lanceoladas, sin nervios evidentes, café-pajiza,. Flores masculinas con periantio 0.5–1.0 mm de largo, glabro, 4-partido, los lóbulos 0.50–0.75 mm de largo, lanceolados, incisos ca. 3/4 de la longitud del periantio, los apéndices subapicales 0.75–1.25 mm de largo; estambres 4, los filamentos 0.75–1.0 mm de largo, las anteras ca. 0.5 mm de largo y 0.4 mm de ancho; pistiloide muy reducido; flores femeninas con lóbulos del periantio levemente desiguales, el dorsal 0.50–0.75 mm de largo, los laterales 0.4–0.5 mm de largo; estaminodios 3, ca. 0.12 mm de largo y de ancho, petaloides; estigma diminuto, penicilado, erecto. Aquenios 0.8–1.0 mm de largo (incluyendo el estigma) y 0.6–0.7 mm de ancho, elipsoides, subcompresos, simétricos, café-pajizos, con una línea punticulada submarginal.

Fenología.—Flores y frutos en mayo.

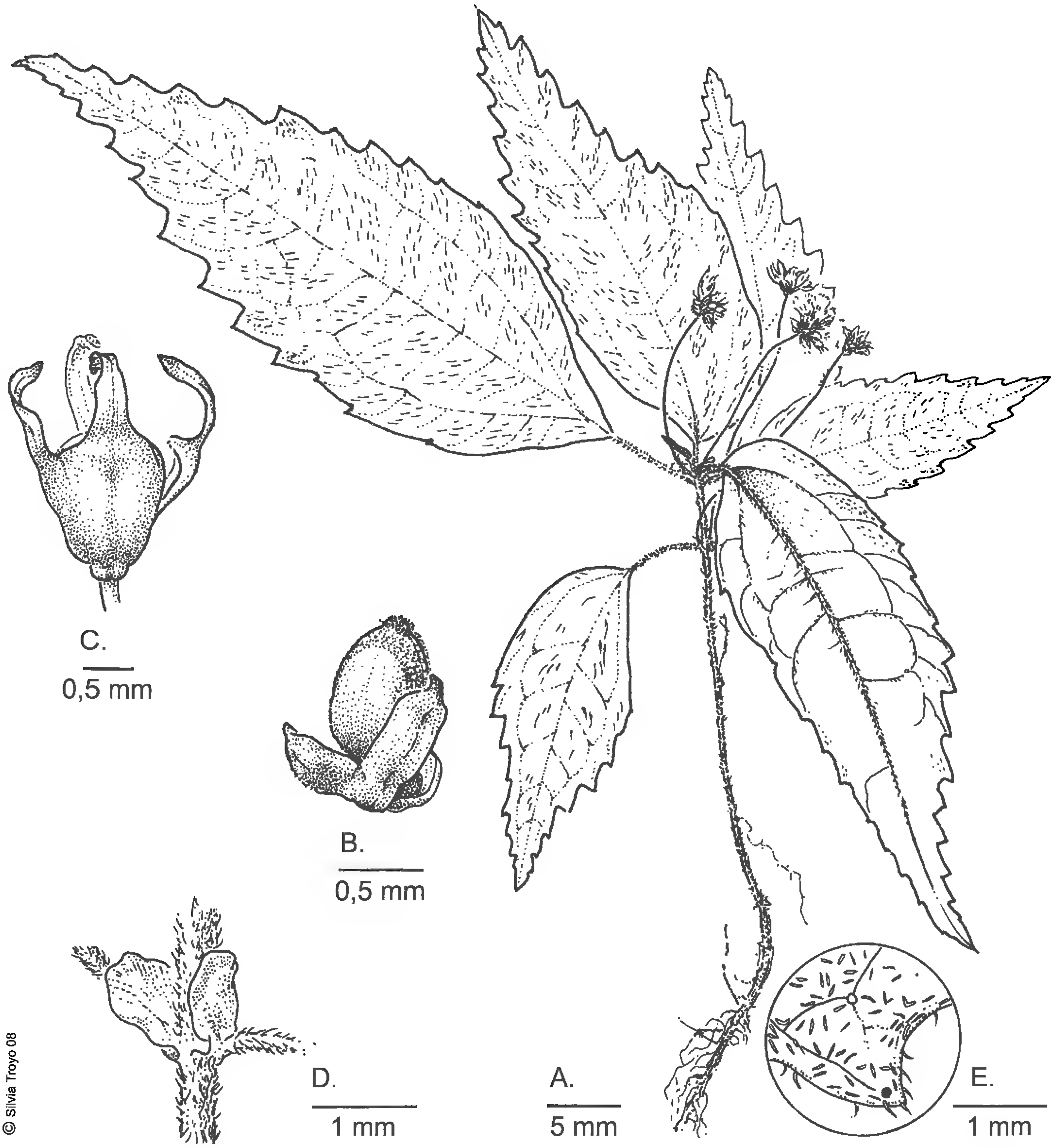

Fig. 5. A–E. *P. moragana* Al. Rodr. & A.K. Monro. A. Hábito; B. Flor femenina; C. Flor masculina; D. Estípulas; E. Cistolitos y pubescencia en el envés de las hojas. A, D, E, basados en *R. Aguilar 1881* (INB); B, C, basados en *M. Moraga 227* (INB).

Distribución y Hábitats.—Endémica de Costa Rica. Se conoce de los bosques húmedos de la vertiente Pacífica en la Península de Osa, 150–700 m.

Discusión.—*Pilea moragana*, según la clasificación de Weddell (1869), pertenece al grupo *Dentatae* y según la clasificación de Killip (1960) al grupo *Molles*. Se reconoce por ser una hierba pequeña con tallos pubescentes, al menos en las partes terminales, las hojas subiguales y con el margen gruesamente dentado, con frecuencia pubescentes y levememente bulladas en el lado adaxial, por sus estípulas reducidas y persistentes, las inflorescencias solitarias, dimorfas, las masculinas en cimas capitadas, en tanto que las femeninas

Tabla 1. Comparación diagnóstica entre algunos caracteres morfológicos de *Pilea acuminata, P. cornuto-cucullata, P. rugosissima* y *P. moragana.*

	P. acuminata	**P. cornuto-cucullata**	**P. rugosissima**	**P. moragana**
Tamaño de estípulas	3–20 mm	3–7 mm	2.5–9.0 mm	1–3 mm
Tamaño de pecíolos mayores	15–90 mm	5–45 mm	10–70 mm	1–16 mm
Tamaño de inflorescencias masculinas	30–100 mm	5–70 mm	25–50 mm	5–25 mm
Tamaño de inflorescencias femeninas	15–100 mm	2.5–60.0 mm	5–20 mm	Ca. 15 mm
Forma de inflorescencias femeninas espigadas	Paniculadas, raras veces cimas	Paniculadas o cimas espigadas	Capitadas	Cortamente ramificadas, pareciendo capitadas
Tamaño de apéndice subapicales del perianto masculino	0.3–1.25 mm	0.2–1.3 mm	2.5–4.0 mm	0.75–1.25 mm
Aquenios con una línea submarginal punticulada	Sí	No	No	Sí
Distribución sobre el nivel del mar	400–1900 m	2000–3400 m	1800–2500 m	150–700 m

son cimas cortamente ramificadas, por sus aquenios con una línea punticulada submarginal y finalmente por su restringida distribución.

Por sus hojas a menudo lanceoladas, gruesamente dentadas, sus tallos en ocasiones pubescentes y sus inflorescencias capitadas, al menos las masculinas, esta especie podría ser confundida con *P. acuminata* Liebm., *P. cornuto-cucullata* Cufod. y *P. rugosissima* Killip (ver Tabla 1).

Esta especie se conoce de pocas recolecciones, todas provenientes de Península de Osa en Costa Rica.

Material examinado. **COSTA RICA. Puntarenas:** Golfito, Parque Nacional Corcovado, El Tigre, Cerro Mueller, 08°27-30'N 83°33-38'W, 150–650 m, 22 May 1988, *C. Kernan & P. Phillips 493* (CR); Golfito, Parque Nacional Corcovado, Península de Osa, Estación Los Patos, cerca de la Estación en bosque primario, 08°34'09"N 83°30'23"W, 250 m, 27 May 1995, *M. Moraga* 227 (INB).

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BOOK REVIEW

Richard B. Primack. 2008. **A Primer of Conservation Biology, 4th Edition.** (ISBN 978-0-87893-692-2, hbk.). Sinauer Associated Inc., 23 Plumtree Road, Sunderland, Massachusetts 01375, U.S.A. (**Orders:** www.sinauer.com, orders@sinauer.com, 413-549-1118 fax). $49.95, 293 pp., 123 illustrations, 9 1/4"× 7 1/4".

Despite its primer epithet, this concise version of the larger *Essentials of Conservation Biology 4th Ed.* delivers an expansive review of the current state of conservation biology. This is an excellent reference for both short-course and non-major elective offerings. The material also begs the development of public outreach lectures. The publisher has in fact developed a companion resource CD that includes electronic versions of all photos, graphs and tables for qualified adopters of the text.

The field of conservation biology has emerged in the past 30 years to address the rapid decline of biodiversity. The first four chapters explore the definitions, value of, and threats to biodiversity. Chapter five discusses the finality of extinction and its impact on the global ecosystem. Chapters six through eight develop the ideas of species and population conservation and conservation in both protected and non-protected areas.

New in the fourth edition is information on global hotspots targeted for conservation efforts and the latest research on endangered species. In the final chapter, the challenges of sustainable development and problems associated with conservation funding are discussed.

I will enthusiastically recommend this well-written and accessible text to the members of my Master Naturalist Chapter and lobby for its inclusion in the State Master Naturalist Curriculum.—*Gary L. Hinds, Chemist, Rio Brazos Master Naturalist, and BRIT volunteer, Fort Worth, Texas, U.S.A.*

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THE *DIOSPYROS SALICIFOLIA* COMPLEX (EBENACEAE) IN MESOAMERICA

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ABSTRACT

The taxonomy of the *Diospyros salicifolia* complex was examined using traditional taxonomic methods and multivariate statistics. Seven species are currently known in Mesoamerica. *Diospyros acapulcensis* Kunth, which occurs from Panama to Jalisco and Veracruz, Mexico, is separable into nine subspecies. *Diospyros aequoris* Standl., a plant of western Mexico from Sinaloa to Oaxaca, is separable into six subspecies. *Diospyros salicifolia* Humb. & Bonpl. ex Willd. is endemic to the Acapulco region of Guerrero, Mexico, and may be of recent hybrid origin. *Diospyros yucatanensis* Lundell, occurring in the Yucatan Peninsula and nearby regions of Mexico and Central America, is separable into two subspecies. *Diospyros intricata* (A. Gray) Standl. is currently known only from the Cape region of Baja California Sur, Mexico. As circumscribed here, interspecific hybridization is thought to be rare in the complex, but intermediates between subspecies sometimes form at the edges of their ranges. Panamanian specimens of putative *D. inconstans* Jacq., belong to this complex, and the recently described *D. amanap* B. Walln., seems to as well. Descriptions are provided for *D. salicifolia, D. acapulcensis, D. aequoris* and *D. yucatanensis*, and within these species nine new subspecies are described, and five new combinations are made. A key to the taxa is provided, along with distribution maps, illustrations and photos of types and living material.

RESUMEN

Se examinó la taxonomía del complejo *Diospyros salicifolia* mediante métodos taxonómicos clásicos y análisis multivariantes. Se conocen normalmente siete especies en Mesoamérica. *Diospyros acapulcensis* Kunth, que se extiende desde Panamá a Jalisco y Veracruz, México, se puede separar en nueve subespecies. *Diospyros aequoris* Standl., una planta del oeste de México que va de Sinaloa a Oaxaca, es separable en seis subespecies. *Diospyros salicifolia* Humb. & Bonpl. ex Willd. es endémica de la región de Acapulco en Guerrero, México, y puede ser de reciente origen híbrido. *Diospyros yucatanensis* Lundell, de la Península de Yucatán y regiones próximas de México y América Central, se puede separar en dos subespecies. *Diospyros intricata* (A. Gray) Standl. se conoce sólo de la región del Cabo de Baja California Sur, México. Tal como están circunscritos aquí, la hibridación interespecífica se piensa que es rara en el complejo, pero a veces se forman intermedios entre subespecies en los extremos de su rango. Especimenes panameños del putativo *D. inconstans* Jacq., pertenece a este complejo, y el recientemente descrito *D. amanap* B. Walln., parece que también. Se aportan descripciones de *D. salicifolia, D. acapulcensis, D. aequoris* y *D. yucatanensis*, y en estas especies se describen nueve nuevas subespecies, y se hacen cinco nuevas combinaciones. Se aporta una clave de los taxa, junto con mapas de distribución, ilustraciones y fotos de los tipos, y de material vivo.

INTRODUCTION

As part of a revision of *Diospyros* for Mexico, a study of the *D. salicifolia* complex was conducted in order to address taxonomic inconsistencies in the literature. We used a combination of conventional taxonomic methods, multivariate statistics and extensive fieldwork in Mexico, in order to resolve uncertainty regarding the proper application of names, assess taxonomic boundaries, emend species descriptions, and construct a useable key for the taxa. Early workers described a number of 3–4-sepalous *Diospyros* in Mesoamerica that seem to form a natural group that we refer to as the *Diospyros salicifolia* complex. Morphometrics, including

J. Bot. Res. Inst. Texas 2(2): 1009 – 1100. 2008

multivariate statistics, were used to explore continuous variation and the utility of quantitative vegetative and reproductive characters in the circumscription of taxa throughout the distribution of the complex in Mesoamerica.

***Diospyros salicifolia* complex:** female flowers solitary, rarely in a 3-flowered cyme with two flowers aborting, or a single female flower terminating an otherwise male inflorescence; calyx lobes 3–4, accrescent (mostly widening, but lengthening markedly in *D. yucatanensis* subsp. *spectabilis*); female flowering calyx mitriform, sometimes tearing or dehiscing at the sinus as the fruit and/or calyx enlarges; styles 3, varying from a fully fused column to free to the base, minutely hairy, stigmas bifid, corolla tube sericeous with 3–4 glabrous zones around the base; fruits with three pairs of locules (these pairs difficult to see in mature fruit, but conspicuous during dissection of immature ovaries), the members of a given pair divided by an apparently complete septum; fruit wall indehiscenct to vaguely or (infrequently) conspicuously dehiscent; flesh ± clear and gelatinous, but becoming reddish, translucent and vitreous when dry; leaves usually evenly distributed along the stem; hairs throughout the plant with fluid-filled lumens, the fluid clear in life, but usually turning reddish upon drying (essentially non-capitate simple glandular hairs–some plants also with occasional non-capitate multi-branched glandular hairs); seeds reddish, especially in life, distributed by birds (White 1978, pers. obs.) and mammals, probably carnivores (pers. obs.).

There are two Mesoamerican *Diospyros* species complexes that could be confused with the *salicifolia* complex.

***Diospyros tetrasperma* complex:** Female flowers usually solitary; calyx lobes 4–5, not markedly accrescent; female flowering calyx not mitriform; interior of the fruiting calyx often ridged and hairy in the upper tube and basal lobe, sinus indehiscent/not tearing; styles 2 pairs or 1 with 5 branches, stigmas 4–5; fruits 4–5 loculed, the locules all divided by a seemingly complete septum; the flesh of the fruit ± gelatinous (rarely fleshy), becoming reddish, translucent and vitreous when dry; leaves sometimes crowded at the ends of stems on short shoots. Members include *D. tetrasperma* Sw., *D. anisandra* S.F. Blake, *D. johnstoniana* Standl. & Steyerm., *D. bumelioides* Standl., and *D. yatesiana* Standl. ex Lundell.

***Diospyros campechiana* complex:** Female inflorescence 1–4-flowered; calyx lobes 4–5, not markedly accrescent; female flowers not mitriform; fruiting calyx weakly attached to the fruit, tending to persist on the pedicel rather than the fruit, the tube spreading and lobes patent to reflexed; style 1 with 2 branches; fruits 1–4-loculed; the amount of flesh present relatively meager by comparison to members of other complexes, reddish, translucent and vitreous when dry (probably clear and gelatinous in life); the hairs minute, and include dark red to nearly black, slightly flexuose to straight, appressed (or nearly so) hairs; seeds few, loosely contained in the fruit of herbarium specimens; leaves medium to large, not crowded on the ends of the shoots, the petioles sometimes with transverse fissures. Members include *D. campechiana* Lundell, *D. hartmanniana* S. Knapp, and *D. panamense* S. Knapp.

Members of the *salicifolia* complex were formerly treated as members of the genus *Maba* J.R. Forst. & G. Forst. (e.g., Hiern 1873) or *Macreightia* A. DC. (e.g., De Candolle 1844). Herbarium specimens often have been identified using Standley's treatment of the group under the genus *Maba* (1924), but typically bear the appropriate combination in *Diospyros* following Standley (1935). Interestingly, no specimens determined as *D. portus* Standl. (= *Maba rekoi* Standl.) were seen during this study, although this little-known taxon appeared in Standley's treatment. Specimens from the Yucatan Peninsula and northern Guatemala are usually identified as *D. yucatanensis* or *D. spectabilis* following Lundell (1937, 1942).

Several workers, such as B. Wallnöfer, C. Whitefoord and S. Knapp, and F. White, ascribe Mesoamerican material of this complex (with the exception of the Baja California endemic *D. intricata*, and *D. amanap* and *D.* aff. *inconstans* from Panama) to *D. salicifolia* Humb. & Bonpl. ex Willd., sometimes with the postscript 'sensu lato.' The different opinions concerning the taxonomic boundaries within this highly variable complex, and the trends seen in the identification of material, are related to the application of three names, *D. acapulcensis* Kunth, *D. salicifolia* Humb. & Bonpl. ex Willd., and *D. albens* Presl. These names are all based on collections from the Acapulco region of Guerrero held in historical European collections at Paris (P), Willdenow (B-W), and Vienna (W) respectively.

TYPE MATERIAL FROM GUERRERO, MEXICO

The name *Diospyros salicifolia*, published by Willdenow in 1806, is based on material ("*Humboldt & Bonpland s.n.*") collected in the Acapulco region of Guerrero, Mexico, and is the oldest name in the complex. Unfortunately, the holotype at Berlin (B-W19250-01) consists only of a branchlet with some very immature leaves, one disconnected mature leaf, and one disconnected fruit (Fig. 1). In preparation of Flora Veracruz, Pacheco (1981) had doubts about the application of the name *D. salicifolia* because the type material is insufficient, and thus used the name *D. veraecrucis* Standl. for plants growing on the east coast of Mexico. However, she mentioned Frank White's suggestion that *D. salicifolia* is the correct name for the species in Veracruz. Whitefoord and Knapp (1998-onward) commented that the type specimen of *D. salicifolia* is "depauperate," but concluded that material they attributed to *D. salicifolia* in southern Mexico and Central America was in agreement with the holotype of *D. salicifolia* based on microfiche ("microficha BM! ex B-W"). Recently, the Botanic Garden and Botanical Museum Berlin-Dahlem has made it possible to view on the Internet a high quality image of the type specimen of *D. salicifolia* held in the Willdenow Herbarium (B-W), including the informative abaxial surface of the mature leaf.

The name *D. acapulcensis* was published in 1818 by Kunth, who worked on the collections of Humboldt and Bonpland in the herbarium at Paris between 1815 and 1828 (Hiepko 1987). The type (Fig. 2a–b) is a specimen in the Paris Muséum National d'Histoire Naturelle (P), unfortunately bearing roughly the same scanty label data as the type of *D. salicifolia* at Berlin, "*Humboldt & Bonpland s.n.*" The locality indicated on the preprinted label is "Amérique Équatoriale." The determination of the specimen as "*Diospyros acapulcensis*" is in the handwriting of Kunth. Because of the general similarity of these two species and the inadequacies of the type specimens, this collection was considered an isotype of *D. salicifolia* by Wallnöfer (by annotation c. 2002) and Whitefoord and Knapp (1998-onward). Wallnöfer also annotated this specimen as the lectotype of *D. acapulcensis* in 2002. As far as we can tell, this lectotypification was not formally published.

The confusion of *D. acapulcensis* and *D. salicifolia* is long standing. In the earliest treatment of the genus to include members of the *salicifolia* complex, Alphonse De Candolle (1844) included *D. salicifolia* in his concept of *Macreightia acapulcensis* (Kunth) A. DC. with a question mark. But, in his monograph of the Ebenaceae, Hiern (1873) stated that "the foliage is sufficiently different" between *D. salicifolia* (= *Maba salicifolia* Hiern) and *D. acapulcensis* (= *Maba acapulcensis* Hiern) for them to be treated as separate species. However, it is unclear to us what material he actually compared, since in reference to *Maba salicifolia*, he cites having seen only "*Humboldt and Bonpland*" from "Equatorial America," which would seem to refer to the type collection of *D. acapulcensis* in Paris. However, this citation seems dubious, since his description of *D. salicifolia* is more consistent with the type at Berlin (*D. salicifolia*) than the type at Paris (*D. acapulcensis*), and lacks a description of the dissected seed mounted on the Paris specimen. We are further troubled by the absence of the *Humboldt and Bonpland* specimen from the enumeration of specimens in Hiern's monograph. Hiern indicates in the introduction to his monograph that he examined the type material in the Willdenow collection at Berlin. It would be astonishing if he had not made use of the type collection of *D. salicifolia*. In reference to *D. acapulcensis*, Hiern cites a single specimen, with the locality data "Mexico, Acapulco, *Bonpland*," which is consistent with label data on a sheet at Paris (P-271690) identified as *D. acapulcensis*, but not currently available to us. Standley (1924) treated *D. salicifolia* and *D. acapulcensis* (under the genus *Maba*) as separate species. In his key he separated them based on differences in leaf shape at the apex and lamina vestiture. He considered material from Acapulco referable to *D. salicifolia*, but did not expand on the distribution of *D. acapulcensis*, other than to state that the type was from Acapulco. The status of these species was still not completely clear.

More recently, *D. salicifolia* and *D. acapulcensis* have been treated as synonyms, apparently beginning with a broad concept of *D. salicifolia* by F. White, but also based on the fact that the two type collections

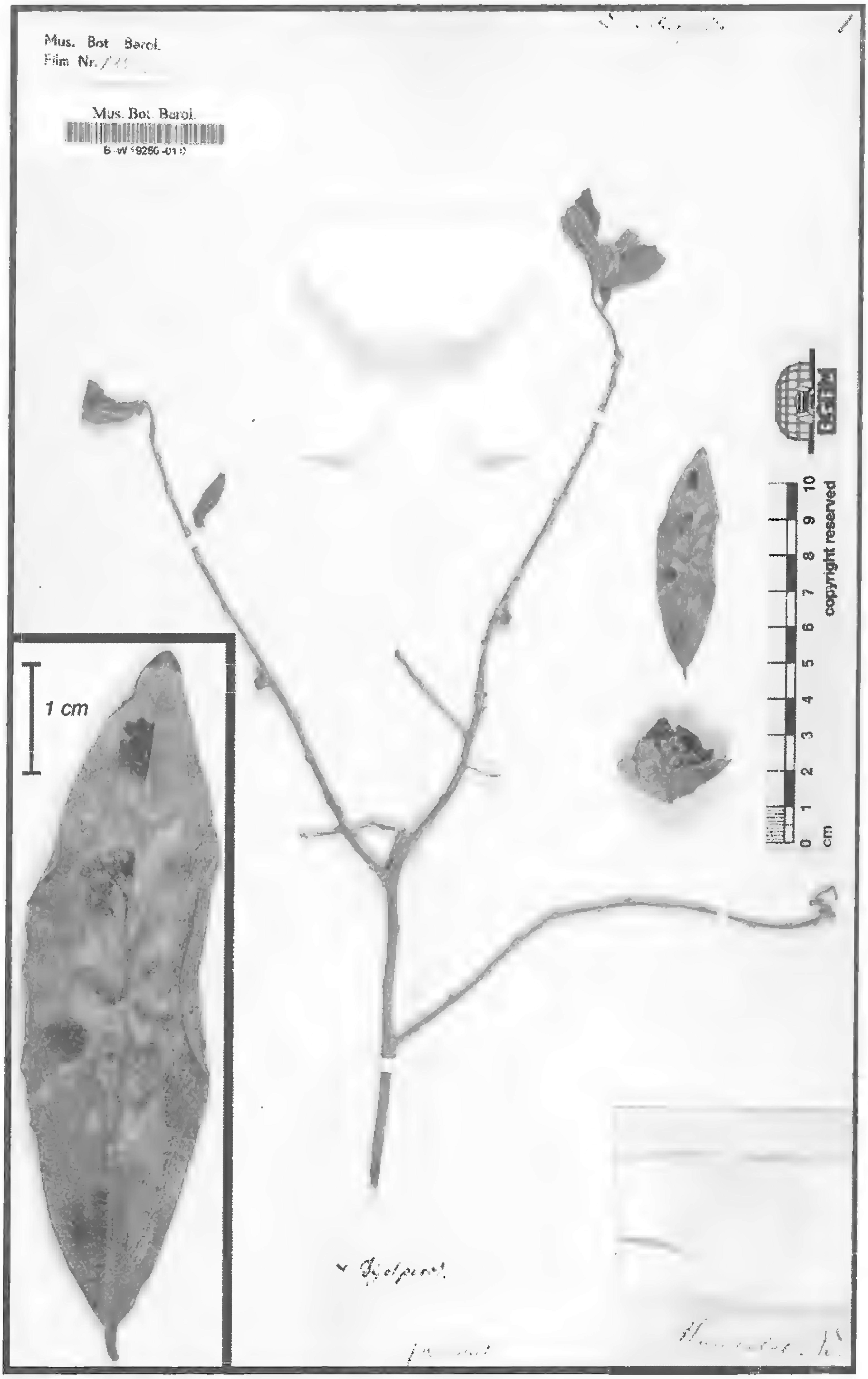
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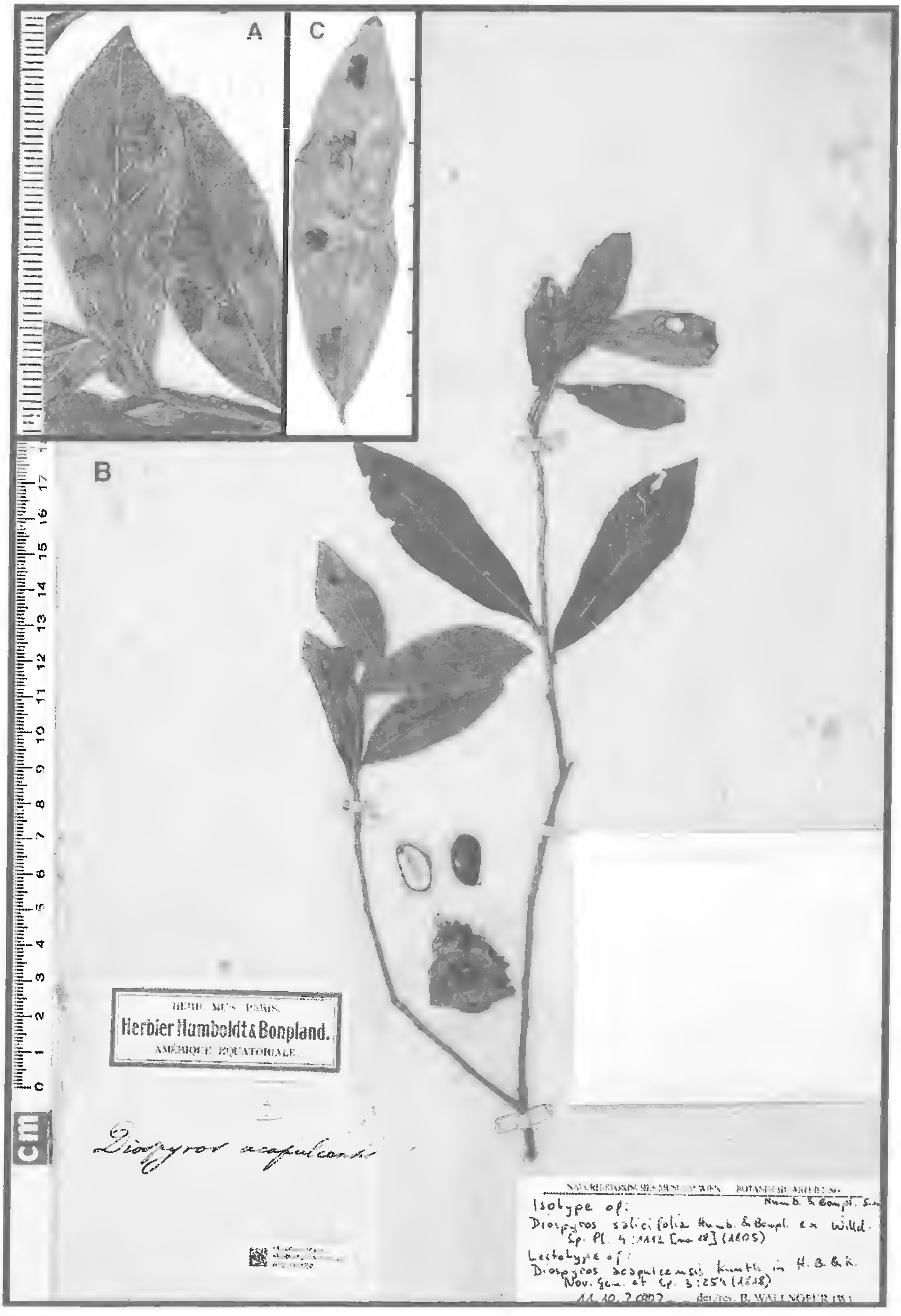
Fig. 1. Photo (Röpert, D) of *Humboldt & Bonpland s.n.* (B-W-19250-01), the holotype of *Diospyros salicifolia* Humb. & Bonpl. ex Willd., with (inset) detail of abaxial leaf surface.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HERB. MUS. PARIS.
Herbier Humboldt & Bonpland.
AMÉRIQUE ÉQUATORIALE.
Diospyros acapulcensis
Isotype of:
Humb. & Bonpl. s.n.
Diospyros salicifolia Humb. & Bonpl. ex Willd.
Sp. Pl. 4: 1112 [no. 18] (1805)
Lectotype of:
Diospyros acapulcensis Kunth in H. B. & K.
Nov. Gen. et Sp. 3: 254 (1818)
11.10.2002 det./rev. B. WALLNÖFER (W)

Fig. 2. A–B. Photo (Museum National d'Histoire Naturelle-Paris) of *Humboldt & Bonpland s.n.* (P-307187), the lectotype of *Diospyros acapulcensis* Kunth. **A.** Abaxial leaf surface. **B.** The annotated specimen. **C.** Abaxial leaf surface of *Diospyros salicifolia* Humb. & Bonpl. ex Willd., from *Humboldt & Bonpland s.n.* (B-W-19250-01).

(B-W-19250-01 and P-307187) have been considered duplicates by some workers. However, the type specimen of *D. salicifolia* (*Humboldt & Bonpland s.n.*) in the Willdenow collection (B-W-19250-01) does not represent the same species as the type of *D. acapulcensis* at the Paris Muséum National d'Histoire Naturelle (P-307187.) These two specimens have therefore been erroneously considered duplicates. The B-W specimen (Figs. 1, 2c) represents *D. salicifolia*, a taxon that is evidently endemic to coastal regions around Acapulco, Guerrero including Isla Roqueta in Acapulco Bay. This species has been collected at Acapulco on a number of occasions in recent times, but nowhere else. The Paris specimen of *Humboldt & Bonpland s.n.* (Fig. 2a–b) represents *Diospyros acapulcensis* (P-307187, designated below as the lectotype). This taxon occurs through much of western Mexico, and while it does occur near Acapulco, in the state of Guerrero it is more common inland in the municipalities of Chilpancingo, Achotla, and Iguala. The closest collections to Acapulco that we have seen are from about 15 km away at 200 m elevation near Rio Papagayo (Fig. 3).

These two specimens also cannot be part of the same gathering because they are in different phenological stages: both specimens have fruit, but the Berlin specimen (*D. salicifolia*) is almost entirely without leaves except for very immature ones at the shoot apices. It represents a collection from the beginning of the growing season, from a plant that had a few old persisting leaves from the previous growing season. The single mature leaf on the collection is elliptical with a base that is rounded to the petiole. The Paris specimen (*D. acapulcensis*) represents a plant from a later phenological stage, as it still has numerous mature leaves, and is without immature leaves at the apex. The laminas on the Paris specimen are all oblanceolate to obovate, and have a cuneate to slightly rounded base. When the abaxial leaf surfaces of the specimens are closely compared (Fig. 2a, c) additional differences are readily apparent. The lateral veins of the Paris specimen are thick and straight and diverge at an acute angle, while those in the specimen at Berlin are finer and diverge at a greater angle, gradually curving toward the leaf apex. The Paris specimen probably came from near Acapulco, but from a slightly more interior location than the Berlin specimen. It is unclear to us what facts Kunth had that indicated the Paris collection was made in a littoral zone, which seems a more likely habitat for *D. salicifolia*. This information may have come from one of the other Paris specimens (currently unavailable to us), in which case, that specimen should be evaluated carefully to see if it is *D. salicifolia*. Other possibilities include miscorrelation of field notes (unknown to us) attributable to *D. salicifolia* collections, or use of the term "littoral" in a very broad sense. There are two other specimens at Paris identified as *D. acapulcensis* that are currently unavailable, but which seem to have label data similar to the chosen (below) lectotype: *Bonpland* s.n. (P-271689) from "Mexico," and *Bonpland* s.n. (P-271690) from "Acapulco, Mexico." The specimen annotated by Wallnöfer as lectotype (P-307187) is consistent with the original description of *D. acapulcensis*. This description gives a rather complete account of seed anatomy, which is consistent with the carefully mounted dissected seed on the specimen favored by Wallnöfer. We believe that P-307187 was important in the initial description of *D. acapulcensis*, and below we formally designate it as the lectotype.

The other species involved in this nomenclatural issue, *Diospyros albens* C. Presl, was described in 1835 from material collected by T. Haenke at Acapulco in about 1791 (although the collection is undated). Based on a photograph of the type (*Haenke s.n.*, W-31942) obtained from Field Museum, the specimen appears to be a collection of *D. salicifolia* with male flowers and young leaves. We cannot separate this material from other specimens of *D. salicifolia* with young leaves (e.g., *W. Boege 452*), and the two names are here treated as synonyms. The name *D. albens* appears occasionally in the literature and sometimes on herbarium specimens. For instance, Standley (1924) seems to have used this name in reference to *D. aequoris* subsp. *tehuantepecensis*, a subspecies proposed here for the state of Oaxaca, and later in reference to the nominate subsp. of *Diospyros yucatanensis* (Standley 1930).

METHODS

Taxonomic Methods.—All of the relevant literature, loaned specimens, including types, and images of types, that could be obtained were evaluated. Additionally, numerous specimens attributable to the *salicifolia* com-

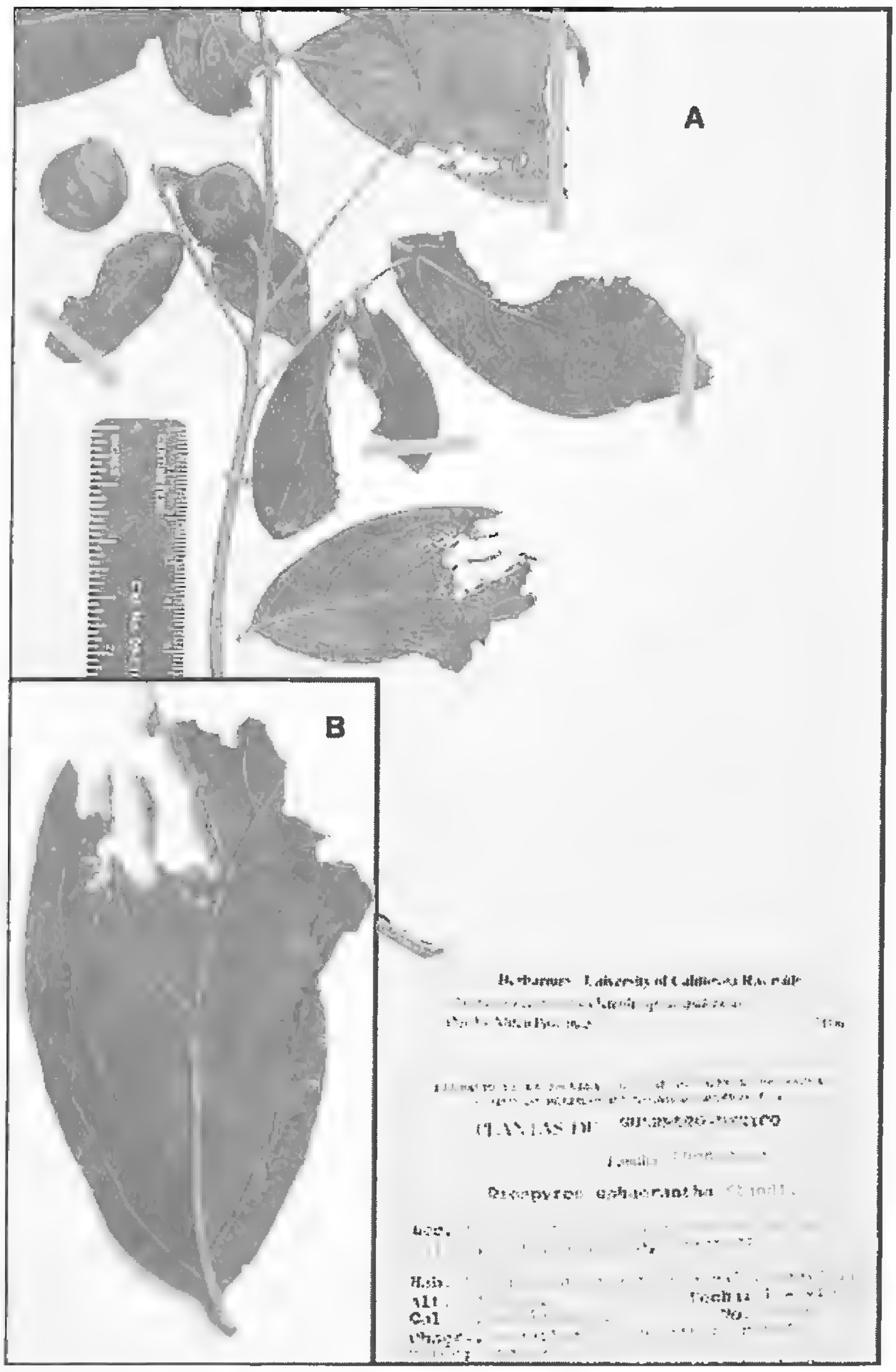


Fig. 3. ***Diospyros acapulcensis*** **subsp.** ***acapulcensis*** **from Puente Rio Papagayo, Guerrero (*R. Fernandez N. 4929,* IEB). A. Fruiting branchlet. B. Abaxial leaf surface.**

plex were collected by the authors in the states of Baja California Sur, Sinaloa, Nayarit, Jalisco, Michoacan, Guerrero, Campeche, and Oaxaca, Mexico and the Nicoya Peninsula, Costa Rica. We have studied about 900 specimens referable to this complex.

We generally agree with de Queiroz (1998, 2007) that species can be thought of as "separately evolving metapopulation lineages," where lineage refers to an "ancestor-descendant series," and metapopulation refers to "an inclusive population made up of several lineages" (de Queiroz 2007) and appreciate his eclectic approach to acceptable lines of evidence that can be used in assessing lineage separation. However, we remain uncomfortable with the practical implications of this general approach for the working systematist, especially given the ambiguities of lineages composing metapopulations, the temporal segments of which in turn compose the other lineages called species, and feel that the "general lineage concept" is not yet operational.

Our approach is been based on examination of morphological variation observed in a sample of specimens preserved in herbaria of the world over the past 200+ years, and in living material encountered (and photographed) during field studies in Mexico and Costa Rica. Collections were sorted into groups based on morphological characters, and secondarily based on geography. We believe that useful taxonomic groups should have unique and generally coherent geographical distributions. Groups identified in our preliminary sorting were considered taxonomic hypotheses warranting continued investigation. Comparisons were made between specimens assigned to each group, and between those specimens and type specimens. We also examined specimens in light of type descriptions, existing floristic and monographic treatments, and the annotations of previous workers. Published names applicable to the identified groups were determined, and the names having priority were determined for each group. Emended descriptions were constructed for species based on studied herbarium specimens and field observations.

De Queiroz does not discuss the use of subspecies or other infraspecific ranks, though these have been widely used by taxonomists, and even though such ranks appear quite appropriate for populations in his zone of lineage separation (de Queiroz 2007, fig. 1) where only some of the properties of species have been acquired. This is the way that infraspecific ranks have traditionally been used by biologists. Here we use the subspecific rank, perhaps in a way similar to other recent workers (e.g., Mulcahy 2007), to communicate our hypothesis of an incipient species within a metapopulation, although in some cases this may represent formerly separate species in the process of merger due to secondary contact resulting from migration and/or environmental change. We are reluctant to describe populations as full species when it appears that botanical exploration between these populations has been inadequate and where the morphological differences separating them are not great. Further exploration could reveal populations with mixtures of the defining characteristics of the two initial populations. Although it is certain that at least some of our subspecies would be treated as full species under concepts treating diagnosable terminal taxa in a cladogram as species (e.g., Mishler & Theriot 2000), we have taken a conservative course in treating them as subspecies. Future studies may reveal that some of our subspecies have diverged more than we can now see and that they are best treated as full species. In any event, we feel it is most important to call attention to these entities. Their taxonomic status can always be changed later, but only if the taxa are first described so that other biologists know they exist.

In accordance with this approach, the material assigned to each species was examined so that consistent differences in morphology, correlated with contiguous geographic areas could be detected. If morphological differences between subgroups within a species proved to be predictive of geography, and the subgroup distributions were allopatric or parapatric, then recognition at subspecific rank was strongly considered. We consider subspecies to be geographic races marked by one or more morphological features, not random variants that appear throughout the distribution of a species. There should be a genetic basis for the morphological variation observed between subspecies, although it is understood that differences in environmental distribution complicate efforts to tease genetic effects apart from environmental influences, especially in baseline taxonomic studies that may have few representatives for certain taxa. In an effort to minimize the influence of environmental factors on our subspecies delimitation, we conducted analyses of covariance using elevation (a proxy for variation in the environment) as a cross effect on leaf and inflorescence traits between subspecies. These analyses (to be presented in a later paper) suggest that quantitative variation in many of these traits is likely to have a genetic component. Furthermore, they highlight an interaction between genetic and environmental factors for some of these traits. In other words, some characters varied inversely with elevation for different subspecies. For instance, the venation parameter leaf width : distance between lateral veins, decreased with elevation for *D. acapulcensis* ssp. *guanacastensis*, while it increased with elevation for *D. acapulcensis* ssp. *rivensis*.

We expect subspecies to hybridize with other subspecies, and if we found that two occupying the same range and habitat did not hybridize with one another, we would propose that they be treated as separate species. But, we do not necessarily expect reproductive barriers to be complete between plant species, although we expect them to be greater than between subspecies.

We carefully studied the floral anatomy of each taxon we could, but descriptions of internal floral structures are still sometimes based on relatively few observations, and the floral anatomy of all taxa needs more study. In this treatment we use 'lanceolate' in the sense of Jackson (1916), being broadest near the lower third of the leaf, not at mid-leaf in the sense of Stearn (2000).

For new combinations, at least one specimen is cited for each relatively small political unit of occurrence (e.g., municipality, department). Most material examined is cited for new subspecies. Collections of interspecific hybrids and subspecific intermediates are cited in Appendix 1. Descriptions apply to herbarium material except when indicated, or when obviously referring to fresh material. Comments on ecology and ethnobotany are based on specimen label data, published field notes, vegetation maps, and personal observations. Map coordinates geo-referenced by the authors are given in brackets. Distribution maps were constructed using The Generic Mapping Tools 4.1.4 (Wessel & Smith 2006) accessed through OMC (Weinelt 2006) and amended using Adobe Photoshop (Ver. CS 8.0, Adobe Systems Incorporated, San Jose, CA). Photographs and illustrations are by the first author unless specified otherwise.

Statistics Methods.—The dataset used in the multivariate statistics consisted of 360 fruiting collections of Mesoamerican *Diospyros* referable to the *salicifolia* complex (a list of accessions is available from the first author). Leaf measurements were based on an average of the three largest leaves, except (rarely) when only two acceptable leaves were present and the specimen was considered especially important for inclusion. The statistical software used was JMP Statistical Discovery (Ver. 6.0, Macintosh Version, SAS Institute Inc., Cary, NC).

Prior to principal component analysis (PCA), strongly correlated characters were identified and eliminated. Since exclusion values are somewhat arbitrary, two such values ($R < 0.7$, $R < 0.8$) were explored. When a correlation was above the exclusion value, one character was retained with preference given to leaf length or leaf width, and lengths over ratios. Leaf length and width were highly correlated. Instead of choosing arbitrarily which of the fundamental lamina measurements should be excluded, we decided to retain two character sets at each exclusion value (i.e., one set with width excluded, the other with length excluded). PCA was used on each of the four sets to discern the relative separation of species groups in multidimensional subspace, and to identify the quantitative variables explaining the most variation in the data. PC scores were scaled to unit variance, thus grouping is discerned from 'GH biplots.' Where the first three components returned eigenvalues greater than one (e.g., many components were needed to explain the observed variation), a varimax factor rotation was performed using all of the components having eigenvalues of one or more in order to make the results interpretable.

TAXONOMIC TREATMENT

The majority of South American *Diospyros* specimens were unavailable for this study, and consequently the distribution of the *salicifolia* complex in South America could not be addressed. Whitefoord and Knapp (1998-onward) reported "*D. salicifolia*" for Columbia, but they did not cite a specimen. We have not seen a specimen of *D. salicifolia* sensu lato from South America, but we do not doubt the presence of *D. acapulcensis* in Columbia. The dearth of available South American specimens also meant that the taxonomic status of *D. inconstans* Jacq. in Mesoamerica could not be addressed completely. All putative Mesoamerican *D. inconstans* specimens we examined were collected in Darien Province, Panama. This material is uniform and we believe it represents a single species perhaps related to, but nonetheless different from, those species represented by the smattering of collections we received from South America and the Caribbean. In our opinion the South American specimens determined by other workers as *D. inconstans* represent more than one taxon. The leaves of the Panamanian material seem consistent with an image seen online (Tropicos.org 2008) of a sterile collection from Columbia (*Bertero s.n.* [MO-1905992]) annotated by B. Wallnöfer as an " "isotype" of: *Diospyros berterii* … = *D. inconstans* s. lat. Jacq." At any rate, the Panamanian collections cited here in Appendix 2 as *D.* aff. *inconstans* are clearly attributable to the *salicifolia* complex, most obviously because of the male flowers in 2–3-flowered cymes, solitary female flowers, the trimerous calyx which is clearly mitriform in the flowers of both sexes, and the overall appearance of the fruiting calyx and mature fruit.

Wallnöfer (2005) recently described a new species, *D. amanap* B. Walln., based on one collection from

Columbia and another from Darien Province, Panama. Although we have not had the opportunity to compare our material with these collections, we think it is unlikely that the *D.* aff. *inconstans* specimens cited here represent *D. amanap*, as they are not in accord with the species description and because Wallnöfer annotated one of the specimens we studied as *D. inconstans* sensu lato. Unfortunately, Wallnöfer did not provide an illustration or photograph of *D. amanap*, or make any comparisons of *D. amanap* to other taxa. The species is described as having a trimerous accrescent calyx and probably a 6-locular fruit (Wallnöfer 2005), and is therefore likely to belong in the *salicifolia* complex.

KEY TO THE MESOAMERICAN SPECIES OF THE *DIOSPYROS SALICIFOLIA* COMPLEX (EXCLUDING *D.* AFF. *INCONSTANS* AND *D. AMANAP*)

1. Petioles < 2 mm long; lamina 10–30(–40) mm long, 5–17 mm wide, obovate, rounded apically, the base cuneate, sparsely to moderately hairy below (densely puberulent when young), the hairs straight, appressed; fruiting calyx small (calyx length + lobe width 12–16 mm); shrubs, mostly < 2.5 m tall; Cape Region of Baja California Sur, including Isla Cerralvo **D. intricata**

1. Petioles > 2 mm long; lamina 18–155 mm long, 11–65 mm wide, shape variable, density of abaxial vestiture, and shape of abaxial hairs variable; fruiting calyx larger (calyx length + lobe width usually (15–)17–25(–32) mm; trees or shrubs, 1–28 m tall; not known from Baja California.

  2. Lamina chartaceous to subcoriaceous, 18–110 mm long, usually elliptic, oblong, oval or nearly circular, the base rounded to subcordate, often coarsely wrinkled above; W Mexico.

    3. Flowering female calyx tube 1.2–1.8 mm long; lamina mostly 60–110 mm long, length : width = 2.2–4.2 : 1; base more narrowly rounded than in *D. aequoris* (length : width at 0.25 = 3.3–4.8 : 1); apex rounded (length : width at 0.75 = 3–4 : 1), lamina not wrinkled above, glabrate to sparsely hairy when mature; 3° venation inconspicuous below, faintly raised or not apparent above; currently known only from the immediate vicinity of Acapulco, Guerrero, < 200 m **D. salicifolia**

    3. Flowering female calyx tube 2.3–6 mm long (1.5 mm long in one subsp. from interior Oaxaca); lamina 18–81 mm long, length : width = 1.1–2.8 : 1; base rounded to subcordate (length : width at 0.25 = 1.5–4.3 : 1); apex rounded to acute (length : width at 0.75 = 1.3–3.5 : 1), lamina often wrinkled above, moderately to densely pubescent below when mature; 3° venation usually prominent below and impressed above; widespread in W Mexico, < 1200 m **D. aequoris**

  2. Lamina membranaceous to chartaceous, rarely subcoriaceous, 45–160 mm long, lanceolate to ovate, or oblanceolate to obovate, sometimes elliptic, oblong or oval, the base rounded, attenuate, or cuneate, decurrent on the petiole, sometimes abruptly, not coarsely wrinkled above; Jalisco, Mexico to Panama.

    4. Flowering female calyx tube 1.2–1.8 mm long; lower lamina surface glabrate to sparsely hairy when mature (moderately hairy when immature), the hairs appressed to subappressed, straight, or nearly so, without swollen remnant hair bases conferring a papillose appearance; currently known only from the immediate vicinity of Acapulco, Guerrero, < 200 m **D. salicifolia**

    4. Flowering female calyx tube 2.5–5.5 mm long (1.8–2 mm long in one Central American subsp.); lower lamina surface sparsely to densely hairy when mature, or if glabrate, then with swollen remnant hair bases conferring a papillose appearance; widespread in Mesoamerica.

      5. Lamina lanceolate or ovate, sometimes oblanceolate, obovate, or elliptic, abaxial vestiture consisting of hairs with swollen bases, conferring a distinct papillose appearance to the lamina, especially in glabrate leaves, the stomatal apparatus nearly always opaque and conspicuous; 2°–3° veins slightly impressed above with a raised vein-lamina seam; fruiting pedicels 2–16 mm long; fruiting calyx tube 2.5–5.5 mm long (tube : pedicel length = 0.2–1.2 : 1); plants often tall and slender; Yucatan Peninsula, Chiapas, Tabasco, SE Veracruz, Mexico, Belize, Guatemala, and NW Honduras, < 270(–1400) **D. yucatanensis**

      5. Lamina oblanceolate to obovate, sometimes elliptic, abaxial surface without conspicuous papillae, or the papillae minute and diffuse (except in one rarely collected subsp. of *D. aequoris* from Honduras), the stomatal apparatus unobvious to opaque and conspicuous; 2°–3° veins usually flush to slightly raised above; fruiting pedicels usually < 6 mm long; fruiting calyx tube 4.5–10 mm long (tube : pedicel length = 1.1–18 : 1); plants not markedly tall and slender; Jalisco, Mexico to Panama, not known from the Yucatan Peninsula, < 1500 m **D. acapulcensis**

1. Diospyros acapulcensis Kunth, Nov. Gen. Sp. 3:254. 1818. (**Fig. 2a–b**). *Macreightia acapulcensis* (Kunth) A. DC. Prodromus Systematis Naturalis Regni Vegetabilis 8:221. 1844. *Maba acapulcensis* (Kunth) Hiern, Trans. Cambridge Philos. Soc. 12:128. 1873. TYPE: MEXICO. GUERRERO: "Amérique Équatoriale" [as on label], "Crescit in litore occidentali Novae Hispaniae, prope Acapulco," "Fructificat Februario" [in protologue], *Humboldt & Bonpland s.n.* (LECTOTYPE, here designated: P-307187, digital image!).

Trees, arborescent shrubs or shrubs, (1–)2–12(–25) m tall, sometimes multi-stemmed clones, facultatively deciduous, mostly dioecious, rarely flowers of both sexes in the same inflorescence (the mating system in need of more study); **trunk** up to 40 cm dbh, bark ± smooth (not slick) to irregularly roughened, or patchy, often lichen encrusted (at least in W Mexico), often in part irregularly scaly, shallowly fissured or checked, especially at major branch forks, coloration uniform to patchy, usually grayish; **wood** yellowish to light brown when dry, reportedly very hard, slash nearly white to light yellow, rapidly turning yellowish, sap clear; **mature stems** terete to subterete, rarely angular, nearly smooth to roughened, fissured, half-netted, verrucose, or knotted, ± glabrous, the epidermis grayish, reddish, or brownish, lenticels often present, minute, circular, and bump-like to large and elliptic, sometimes fissure-like and forming a reticulum; **2nd year stems** terete to angular, smooth to half-netted, the bark sometimes sloughing, often longitudinally ridged, minutely fissured, bumpy, or verrucose, glabrous to sparsely hairy, rarely moderately to densely hairy, often with remnants of desiccated hairs, these sometimes coated with exudate, the epidermis viscid, often black gland dotted, occasionally mottled with reddish-brown or black, lenticels usually present; **1st year stems** quadrangular to subterete, smooth to verrucose, sometimes sulcate, sparsely to densely hairy, the hairs straight, wavy, curly, kinked, distally curved or hooked, 0.2–2 mm long, spreading to appressed, sometimes retrorse, hairs often reddish (the hairs throughout the plant are mostly simple glandular hairs, translucent in life, but variously colored in herbarium specimens due to darkening of a fluid in the lumen), clavate glandular hairs often present, deciduous, leaving the epidermis viscid, the epidermis green in life, grayish, reddish, or brownish in dry material, sometimes minutely lenticellate, *bud scales* ovate, concave, covered with appressed hairs. **Leaves** alternate, simple, entire; **petioles** (2–)4–7(–9) mm long, sometimes minutely winged, glabrous to densely hairy, clavate glandular hairs also sometimes present, these deciduous, leaving the epidermis viscid, sometimes without clavate glandular hairs and the epidermis dull, surface smooth to rugose, sometimes glaucous, pruinose or scintillant, lower surface convex, upper surface slightly concave or shallowly canaliculate to convex; **lamina** chartaceous to subcoriaceous, membranaceous when mature in one subspecies (shade and spring leaves often membranaceous), 45–125(–160) mm long, (15–)18–60(–65) mm wide, the length to width ratio (1.7–)2–3.6(–4.4) **:** 1, mostly oblanceolate to obovate, sometimes elliptic, oblong or oval, usually slightly wider in the distal half, sometimes obtrullate, rarely lanceolate or ovate, clavate glandular hairs often present, deciduous, leaving the epidermis viscid, the epidermis color variable, but darker above, *base* cuneate to long or short attenuate, decurrent on the petiole, *margin* flat to revolute, sometimes ciliate, *apex* acute to obtuse, acuminate or tapered to a blunt point, rounded, or mucronulate; **lower lamina surface** sparsely to densely hairy, rarely glabrate, the hairs variable, often deciduous, the epidermis often viscid, coloration sometimes mottled, the stomatal apparatus clear or off-white, opaque, and conspicuous, and then may be mistaken for scales; **upper lamina surface** glabrous to moderately hairy, the hairs often wavy and upright to ascending, usually deciduous, their bases sometimes thickened, annular seeping glands sometimes appearing where hairs have fallen, stellate hairs occasionally present, often crystal-papillose (with aggregates of opaque off-white excrescences), more obviously so in thinner leaves (rarely on the abaxial lamina surface), sometimes tented (with minute well spread-out waves or peaks along veins of the lamina surface caused by differential drying in herbarium specimens). **Venation** arcolanguid (Provance & Sanders 2005) to brochidodromous, sometimes eucamptodromous, 3(–5)-ribbed, often darkened on the lower surface of young leaves; **midrib** usually prominent below, glabrate to densely hairy, smooth to rugose, sometimes glaucous, pruinose or scintillant, slightly impressed to convexly-raised above near the base, flush to slightly raised distally, usually impressed along the lamina-midrib seam, hairs tending to be upright, clavate glandular hairs often present, deciduous, leaving the epidermis viscid; **lateral veins** 5–12 on each side of the midrib, often the basal pair and/or the second from the base, diverging from the midrib at a more acute angle and with a straighter course than the others, raised below, flush to slightly raised above; **3° veins** obscure to conspicuously raised below, usually flush or inconspicuously raised above; **4°–5° veins** obscure to barely raised. **Laminar extrafloral nectaries** nearly always present on the lower lamina surface (very rarely on the upper surface), tending to be near the midrib in the proximal half of the lamina, minutely rimmed, flat to concave, slightly raised to sunken in the lamina, elliptic, round or amorphic, mostly 0.3–1.5 mm in longest dimension, green in life, drying greenish, reddish, brownish or black. **Male inflorescences** solitary (2–)3–5(–7)-flowered cymes in leaf axils of young (usually 1st year) stems, cymes of male flowers rarely terminated by a female flower, moderately to densely hairy, the hairs minute, nearly straight to wavy or kinked, upright to ascending, tawny or dull orange to reddish or dark brown, epidermis sometimes viscid, straw, yellowish, dull orange, light brown, golden brown, reddish-brown, or dark brown; **peduncles** 1–6 mm long, often angular; **pedicels** 0.5–3 mm long, broadening distally, bracts linear-elliptic to ovate, 1–2.5 mm long, often navicular. **Male flowers** 3–4-merous; **male flowering calyx** narrowly campanulate to campanulate or infundibuliform, exterior hairs moderate to dense, sometimes glabrous near the sinuses, the hairs minute, otherwise as variable as those of the stems (but not retrorse), clavate glandular hair sometimes present, epidermis often viscid, *tube* (1.5–)2–4 mm long, 3(–4) mm wide, sometimes keeled from sinus to the base, *lobes* valvate-reduplicate in the bud, lanceolate to ovate, 1.5–6 mm long, 1.5–4 mm wide, apex acute, sometimes acuminate; **male corolla** in life white, cream, yellow, or red (reportedly, perhaps in error) in life, the exterior hairs in dry material off-white, pinkish, tawny, yellowish, orangish, reddish or brownish, interior glabrous; **male corolla tube** urceolate to narrowly urceolate, narrowing distally, (2.8–)3–7 mm long, 2–4 mm wide, with three shield-shaped, 1–2.5 mm long, glabrous zones at the base (shielded), or sometimes the basal 1/4–1/2 of the tube completely glabrous, otherwise sericeous with an undercoat of minute curly to straight hairs, minute hairs (including occasional retrorse hairs) sometimes present between the sericeous and glabrous zones; **male corolla lobes** spreading in life, lanceolate, ovate, rhombic or elliptic, 2–3.5 mm long, 1–2.8 mm wide, hairs dense, minute, curly to wavy, with some straight intramarginal hairs, these sometimes retrorse, median sericeous, at least basally. **Stamens** 12(–14); **filaments** adnate to the corolla at or near the base, or inserted on the receptacle, or both, usually in tiers or groups of six stamens, sometimes geminate, 0.8–2 mm long; **anthers** lanceolate, ovate or oblong, 1.2–3 mm long, apex acuminate, rostrate, aristate, or bluntly pointed, opening by longitudinal slits. **Pistillode** minute, densely hairy, the hairs wavy to straight. **Female inflorescences** solitary flowers in leaf axils of young (often 1st year) stems, rarely 3-flowered cymes; **female flowering pedicels** with hairs and epidermis similar to male inflorescences. **Female flowers** 3–4(–5)-merous; **female flowering calyx** mitriform, exterior moderately to densely hairy, the vestiture and epidermis the same as in male flowering calyces, interior vestiture similar to interior fruiting calyx, *tube* cupulate to cylindrical, 1.8–5.5 mm long, 3.5–5 mm wide, sometimes very thick, especially basally, *lobes* valvate-reduplicate in the bud, winged, broadly rounded to ovate, (2–)3–8.5 mm long, 4–10 mm wide, apex vaguely acuminate or bluntly acute, nerves sometimes conspicuous; **female corolla** range of coloration similar to that of male corollas; **female corolla tube** narrowly to short urceolate or subcylindrical, narrowing distally, 2.7–7 mm long, 2.3–3.5 mm wide, exterior vestiture similar to male corolla tubes, interior glabrous; **female corolla lobes** spreading in life, lanceolate to ovate or rhombic, 2–4 mm long, 1–2 mm wide, margins often glabrous and partly involute, exterior vestiture the same as for male flowers, interior glabrous; **ovary** depressed- globose to subglobose, turbinate, or obturbinate, 2–3 mm long, 1.5–4.5 mm wide, sometimes vaguely 3-lobed, sparsely hairy to sericeous, hairs variously colored, longer hairs sometimes present at the base, rarely with shield-shaped glabrous zones similar to those of the corolla tube; **styles** 3(–4), usually fused into a column part of the way and spreading distally, 1–3 mm long, usually densely hairy; **stigmas** bifid, about 0.8 mm long, exterior sometimes hairy. **Fruiting pedicels** terete to angular, often broader distally, 0.5–9 mm long, sometimes fissured or half-netted, sometimes lenticellate, vestiture persisting or becoming glabrous, epidermis often viscid, bracts (0–)1–2, alternate or opposite, lanceolate to broadly ovate or deltate, 1.2–2.5 mm long, 0.9–2.5 mm wide, flat, concave or navicular. **Fruiting calyx** slightly accrescent, campanulate or infundibuliform to explanate, the sinus sometimes tearing, exterior vestiture as described for flowering calyces or glabrate, often with pale desiccated remnants of original vestiture, epidermis often conspicuously viscid and darkened, *tube* (3–)4–10 mm long, sometimes bulbous at the base, interior sparsely to densely hairs, the hairs usually appressed to subappressed and distally directed, variously colored, hairy to the base or glabrous in the lower 1/10–1/2, epidermis sometimes with dark blotches, *lobes* obtuse to rounded, rarely acute, reflexed (basally, near the apex, or along the margins) to ascending, (2–)3–7.5(–9) mm long, 7–15(–16) mm wide, apex usually abruptly acuminate to a blunt point, interior intramarginal band of hairs variable in width, the hairs usually dense, minute, wavy, curly or kinked, upright, epidermis usually viscid, hairs of the median usually dense, straight, appressed, and similar in color to those of the intramargin. **Fruit** a subglobose to depressed-globose berry, 1.5–3.5 cm in diameter, consistently with three pairs of locules; **flesh** gelatinous, sweet when ripe, with variable amounts of remnant astringency, becoming vitreous, red and translucent upon drying; **epidermis** smooth to orange-peel textured, glabrous to sparsely and weakly hairy when mature, a basal ring of subappressed, fine, straight hairs sometimes present (the ring sometimes adhering to the base of the calyx tube), the apex sometimes umbilicate, usually densely and minutely hairy, in life green when unripe and yellow, orange, or light brown when ripe, rarely red, in herbarium material yellow, dark yellow, orange, golden brown, or brown. **Seeds** 6, wedge-shaped (resembling an orange segment with rounded edges), 11–16 mm long, 5.5–8 mm radial depth, 3.5–6 mm wide, brick red to dark brown, texture rugulose-foveolate.

KEY TO THE SUBSPECIES OF *DIOSPYROS ACAPULCENSIS* IN MESOAMERICA

1. Fruiting pedicels 0.3–1 mm long; lamina obtrullate, 40–50 mm wide at 3/4 length, reddish-brown, densely hairy below when young, glabrate when mature, the curly to slightly wavy hairs with swollen bases, leaving annular glandular papillae after the hairs fall; fruiting calyx nearly black, glabrescent to sparsely hairy, lobes 12–13 mm wide, apices reflexed; pine forests of SW Honduras, 750–1120 m ________ subsp. **mejocotensis**
1. Fruiting pedicels > 2 mm long; lamina rarely obtrullate, rarely over 45 mm wide at 3/4 length; color and vestiture of lamina and fruiting calyx variable; fruiting calyx lobes 7–16 mm wide, apices reflexed or not; Jalisco, Mexico to Panama, including Honduras.
  2. Fruiting calyx lobes 7–7.5 mm long, base of calyx tube swollen; mature lamina (e.g. in fruiting specimens) membranaceous to subchartaceous, apex narrowly acute to narrowly acuminate, base narrow (length : width at 0.25 c. 5 : 1), abaxial hairs straight, appressed, distally directed; male cymes terminated by female flowers; anthers yellow with red dots; Chiquimula vicinity, SE Guatemala, 400–1000 m ______ subsp. **chiquimulensis**
  2. Fruiting calyx lobes usually 3–6 mm long, base of calyx tube swollen or not; mature lamina chartaceous (rarely membranaceous or subcoriaceous), apex rounded to acute, sometimes acuminate, but not narrowly acuminate (except in subsp. *dwyeri*, and sometimes in subsp. *veraecrucis*), less narrowed basally (except in subsp. *dwyeri*) (length : width at 0.25 usually < 5 : 1), abaxial hairs variable; inflorescences not as described above; anthers not red dotted; Jalisco, Mexico to Panama, including Guatemala.
    3. Hairs of lower lamina surface straight, appressed, distally directed.
      4. Fruiting pedicels > 6 mm long; fruiting calyx lobes < 9.5 mm wide; leaves narrow, especially basally (length : width at 0.25 > 5.5 : 1); known only from Panama ________ subsp. **dwyeri**
      4. Fruiting pedicels < 6 mm long; fruiting calyx lobes mostly > 10 mm wide; lamina sometimes narrow, but less narrow basally (length : width at 0.25 usually < 5 : 1), Mexico to Costa Rica.
        5. Lower lamina 3° venation not raised, sometimes apparent due to darkened coloration, the span of the four centermost lateral veins usually < 40 mm; petioles 2–6 mm long; lamina 45–105(–120) mm long, width at 0.75 length 15–29 mm; fruiting calyx tube mostly 5.5–9 mm long, the lobes 9–15.5 mm wide; S Mexico (except the Yucatan Peninsula), W Guatemala and El Salvador, < 1240 m ________ subsp. **veraecrucis**
        5. Lower lamina 3° venation prominently raised, the span of the 4 centermost lateral veins usually > 40 mm; petioles 4–8 mm long; lamina 78–130(–150) mm long, width at 0.75 length (21–)24–40 mm; fruiting calyx tube 3.5–7 mm long, the lobes 6.5–13 mm wide; often near the Pacific Coast of Nicaragua and NW Costa Rica, < 150 m (rarely to 600 m) ________ subsp. **rivensis**
    3. Hairs of lower lamina surface curly to straight, not appressed, not strictly distally directed.
      6. Lower lamina reddish-brown, the vestiture (including the midrib) dense, the hairs curly or kinked, golden-brown to reddish-brown; petioles rugose, glaucous-pruinose and mauve to dark purple; fruits up to 35 mm in diameter; gallery forests, mostly WC Nicaragua ________ subsp. **pedromorenoi**
      6. Lower lamina (including the midrib) epidermis and vestiture color various, glabrate to densely hairy, the hairs straight to wavy; petioles not as above; fruits < 30 mm in diameter; W Mexico, Guatemala, Honduras, Nicaragua, and Costa Rica (one subsp. rare in El Salvador).
        7. Lamina often elliptic, length : width 2.1–3.8 : 1; adaxial lamina surface often laden with clusters of opaque white crystals (crystal-papillose), and often with minute peaks and waves along veins

caused by differential drying (tented); hairs on the abaxial midrib surface appressed to subappressed; coastal Nicaragua and Costa Rica, < 150(–600) m ____ subsp. **rivensis**

7. Lamina oblanceolate to obovate, rarely elliptic, length : width 1.7–2.7(–3.3) : 1; adaxial lamina surface crystal-papillose or not, sometimes tented; hairs on the abaxial midrib surface ascending, spreading or retrorse; W Mexico, Guatemala, Honduras, Nicaragua, and Costa Rica (one subsp. rare in El Salvador).
   8. Hairs of inflorescence dense, gold to reddish-gold; hairs of the upper lamina similar, but with swollen bases, deciduous, leaving seeping annular papillae; fruits often dark brown; endemic to Costa Rica ____ subsp. **guanacastensis**
   8. Hairs of inflorescence and leaves not as above; fruits not drying dark brown; plants of W Mexico, Guatemala, Honduras, Nicaragua, and rarely El Salvador (subsp. *nicaraguensis*).
      9. Fruiting calyx glabrous inside near the base, lobes usually ≤ 10.5 mm wide; lamina (63–)82–140 mm long, mostly (20–)29–50(–63) mm wide, 24–43(–47) mm wide at 0.75 length; SE Guatemala, Honduras, Nicaragua, rarely collected in El Salvador ____ subsp. **nicaraguensis**
      9. Fruiting calyx hairy inside to the base, lobes rarely < 11 mm wide; lamina 50–82(–127) mm long, usually (18–)23–39(–44) mm wide, < 29 mm wide at 0.75 length; W Mexico and W Guatemala ____ subsp. **acapulcensis**

1a. Diospyros acapulcensis Kunth subsp. acapulcensis. (Figs. 2a–b, 3, 4, 5, 19c).

Trees to shrubs, 2–14 m tall; **trunk** to 30 cm dbh., bark light grayish-brown; **stems** glabrous to sparingly hirsutulous, young stems puberulent and wavy-hairy. **Petioles** (2.5–)3.5–6(–7) mm long, glabrous to densely hairy, the hairs wavy to straight, ascending to retrorse, sometimes glandular above. **Lamina** chartaceous, 50–105(–128) mm long, (18–)23–39(–44) mm wide, length to width ratio (1.8–)2–2.8(–3.3) : 1, oblanceolate to obovate, sometimes nearly elliptic, *base* cuneate to acutely rounded, sometimes attenuate, decurrent on the petiole, *margin* flat to minutely revolute, *apex* acute to broadly acuminate, occasionally rounded; **lower lamina surface** sparsely to densely hairy, the hairs straight to wavy, ascending to upright, not strictly apically directed, clavate glandular hairs present, but deciduous; epidermis dull light brownish- green, the stomatal apparatus translucent, sometimes opaque and conspicuous; **upper lamina surface** sparsely to densely erect-villous, epidermis sometimes crystal-papillose. **Venation** brochidodromous to arcolanguid; **midrib** pubescent or hirsute to wavy-hairy below, especially along the sides, the hairs sometimes ascending, tawny or orangish, finer above, sometimes retrorse basally; **lateral veins** 5–8 per side, prominent below, flush to raised and apparent above; **3° veins** barely raised below, flush or slightly raised above. **Male inflorescences** 1–3(–5)-flowered cymes; **peduncles** 1–2 mm long; **pedicels** 1.5–2 mm long, bracts oblong-lanceolate, 1–2 mm long, navicular. **Male flowering calyx** sericeous inside to the base to glabrous, ascending wavy-tomentulose outside, epidermis viscid and dark, *tube* 2–4 mm long, 3–3.5 mm wide, *lobes* acute, 2–4 mm long, 2–3 mm wide; **male corolla tube** 3.5–6.5 mm long, 2–3 mm wide, exterior basal 1/3 glabrous, otherwise tawny sericeous, bordering region scantily retrorse-puberulent; **male corolla lobes** lanceolate to oblong-ovate, 2 mm long. **Stamens** 12; **filaments** adnate in two tiers to the corolla, the inner basal, the outer tier just above, 1–1.8 mm long; **anthers** oblong-ovate, 2 mm long, rostrate. **Female inflorescences** densely hairy, bracts opposite, 1.5–2 mm long, similar to male bracts. **Female flowering calyx** short-mitriform, interior cream to tawny sericeous to the base, the intramarginal band wide, exterior tomentulose, with scant slightly longer, wavy, ascending hairs, *tube* cupulate, thickened near the base, 4–5.5 mm long, 4.5–5 mm wide, *lobes* broadly rounded, (2–)4–8 mm long, 8–10 mm wide; **female corolla tube** 5.5–6 mm long, 3 mm wide, exterior lower 1/2 glabrous, upper 1/2 sericeous, the bordering region scantily retrorse-puberulent; **female corolla lobes** lanceolate to ovate, 2.5 mm long, 1.3 mm wide; **ovary** depressed-globose, 2.5 mm long, 4.5 mm wide, minutely cream sericeous; **styles** 3, ± 1.8 mm long, partly fused, densely hairy; **stigmas** vaguely bifid, 0.8 mm long, minutely appressed hairy; **staminodes** (3–)6(–9), adnate to the corolla from the base to mid-tube, the free portion 1.2–1.4 mm long, sometimes inserted on the receptacle, the sterile anthers knife-shaped, 1 mm long, basally asymmetric, the filament flattish. **Fruiting pedicels** stout, 1–4.5(–6) mm long. **Fruiting calyx** rotate to campanulate, often splitting at the sinuses, exterior glabrate or with persisting desiccated hairs, epidermis viscid, dark brown, *tube* (5–)6–10

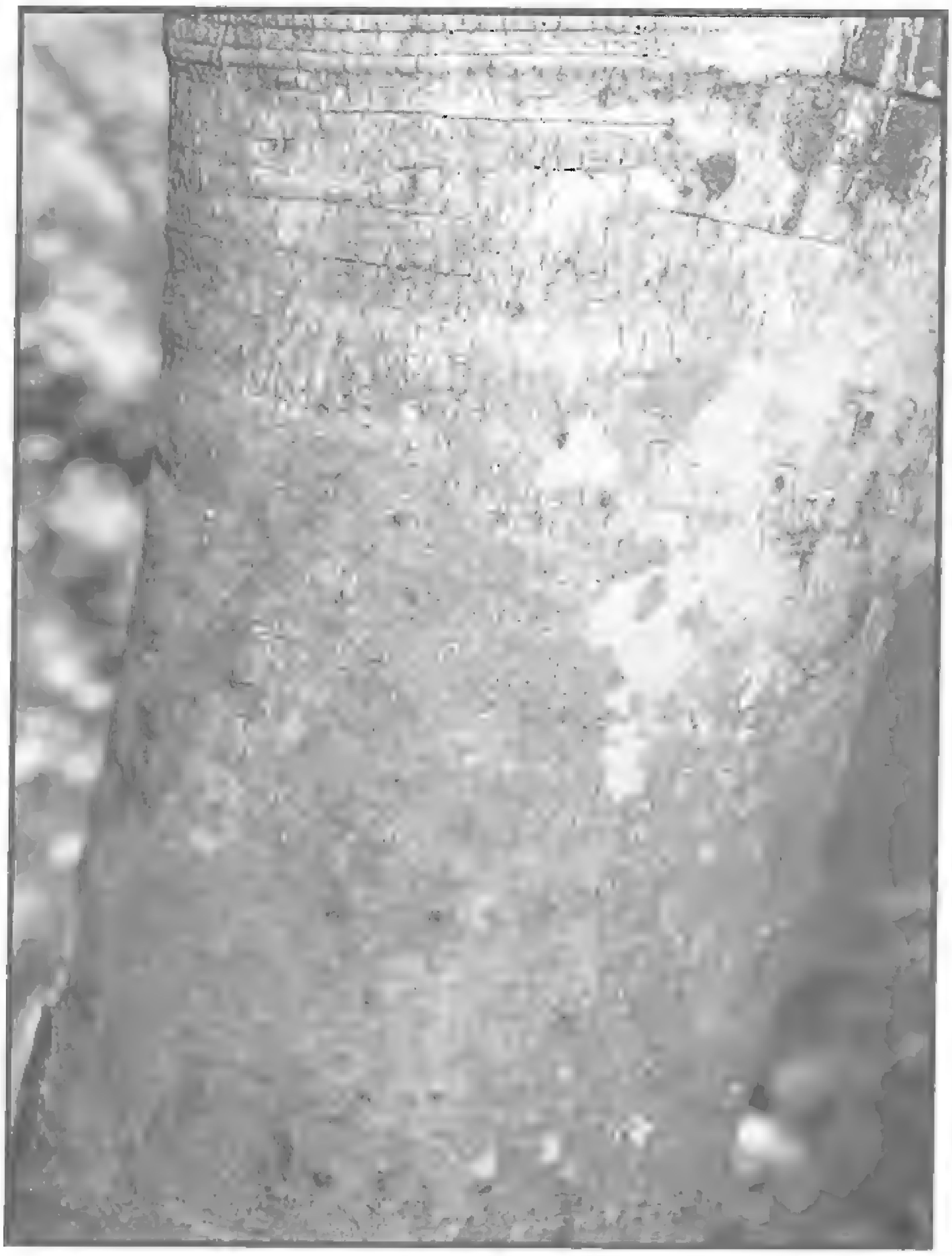


Fig. 4. Trunk of *D. acapulcensis* subsp. *acapulcensis*. Chorros del Varal, Jalisco/Michoacan, with ± smooth bark except in the branch fork where shallowly checked.

mm long, often bulbous near the pedicel, *lobes* obtuse, (2–)4–7(–9) mm long, (9.5–)11–15(–16) mm wide, reflexed, margins sometimes reflexed. **Fruit** subglobose to depressed-globose, 1.5–2 cm long, 1.5–2.5 cm in diameter, with slightly wavy to straight golden subappressed hairs at the base, these dense at the apex, epidermis often glaucous-pruinose and/or scintillant, yellowish to golden brown. **Seeds** 11–14 mm long, 6–8 mm radial depth, 4–5 mm wide.

Diospyros acapulcensis subsp. *acapulcensis* is nearly endemic to western and southwestern Mexico, but is unknown from Oaxaca (Fig. 23), and is known elsewhere only from a single collection from Guatemala. It is an infrequent to occasional component of matorral, tropical deciduous forest, seasonal evergreen forest, and oak forest, in canyons and on slopes and mesas below 1350 m. Like many taxa in the complex, it may persist or be spared along roadsides and at the edges of cultivated land. It resembles *D. a.* subsp. *veraecrucis*, but is differentiated by the abaxial lamina pubescence (see subsp. *veraecrucis*) and the shape of the lamina. It also closely resembles *D. a.* subsp. *nicaraguensis*, but that differs in having a lamina that tends to be longer and wider, narrower fruiting calyx lobes, and a calyx tube that is usually not sericeous inside to the base.

Representative specimens. **GUATEMALA. Huehuetenango:** Sierra de los Cuchumatanes, 800–1200 m, 30 Aug 1942, *J.A. Steyermark 51584* (F). **MEXICO. Chiapas. Mpio. Chiapa de Corzo:** above El Chorreadero, 800 m, 11 Aug 1972, *D.E. Breedlove 26874* (MO, CHAPA).

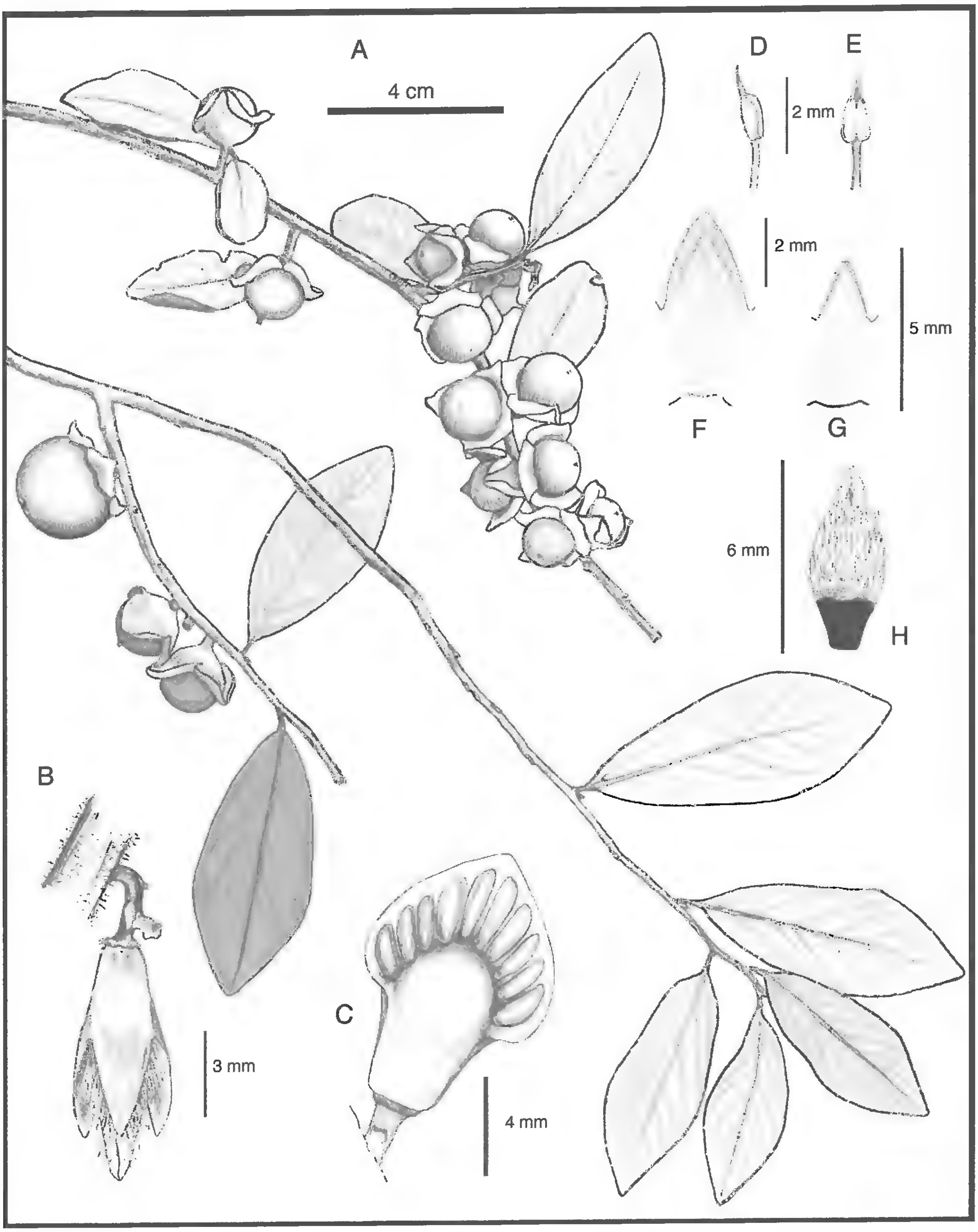


Fig. 5. Diospyros acapulcensis subsp. acapulcensis. A. Fruiting branchlets (M.C. Provance et al. 9398, UCR). B. Male flower (G.B. Hinton et al. 6044, MO). C. Female immature flower (J. Steyermark, F). D–E. Based on E. Carranza & E. Perez C. 4743 (IEB). D. Stamen (lateral view). E. Stamen (adaxial view). F. Adaxial surface of male calyx (Kruse 1636, MO). G–H. Based on J. Rzedowski 22806 (MSC). G. Adaxial surface of male calyx. H. Immature male corolla.

Mpio. Terán: 6.5 km W of Tuxtla Gutiérrez, 600 m, 8 Oct 1971, *D.E. Breedlove 20121* (MO). **Mpio. Tonalá:** Tonalá, 100 m, 6 May 1988, *J.I. Calzada 13814* (XAL). **Mpio. Tuxtla Gutiérrez:** Tuxla Gutiérrez–El Sumidero, km 16, 990 m, 19 May 1982, *J.I. Calzada 9223* (IEB, XAL). **Mpio. Tzimol:** 15 km S of Comitan, 1200 m, 19 Nov 1980, *D.E. Breedlove & F. Almeda 47619* (MO). **Mpio. Venustiano Carranza:** above Soyatitán, 3400 ft, 25 Oct 1967, *A. Shilom Ton 3105* (CAS). **Mpio. Villa Corzo:** near El Brillante, 650 m, 9 Oct 1974, *D.E. Breedlove 38411* (MO). **Colima. Mpio. Comala:** cerca de Campo Cuatro, 1200–1300 m, 5 May 1998, *R. Cuevas 5858* (ZEA). **Mpio. Tecoman:** 1.5–2.5 km de la empresa "Apasco," 400–560 m, 6 Apr 1996, *R. Cuevas & L. Guzmán 5133* (ZEA). **México. Mpio. Temascaltepec:** Palmar, 13 May 1934, *G.B. Hinton et al. 6044* (MO). **Guerrero. Mpio. Acapulco de Juarez:** Río Papagayo, 3 km NW de Xalapa, 200 m, 17 Jan 1994, *R. Fernandez N. 4929* (IEB). **Mpio. Chilpancingo:** Salto Valadéz, 1350 m, 25 Jan 1970, *H. Kruse 2692* (MO); al N de Acahuizotla, camino a Palo Blanco, [17°23'N, 99°27'W], 930–1050 m, 19 Jan 1994, *E. Carranza & E. Perez C. 4743* (IEB). **Mpio. Iguala:** E de Tierra Colorada, 300 m, 8 Jul 1966, *J. Rzedowski 22806* (MSC). **Mpio. Mochitlán:** Agua de Obispo, barranca del Cuarenta, 945 m, 15 Jul 1967, *H. Kruse 1636* (MO). **Mpio. San Marcos:** Piedra Grande, 310 m, 31 Jan 1983, *J.S. Miller & P. Tenorio L. 553* (MO). **Mpio. Taxco:** 7 mi N of "Centro" sign at Iguala, 25 Jan 1971, *J. Freeland & L. Spetzman 50* (ARIZ, NA). **Jalisco. Mpio. Autlan de Navarro:** Arroyo El Coajinque, 1000 m, 3 Oct 1998, *R. Cuevas 5872* (ZEA). **Mpio. Casimiro Castillo:** camino Piedra Pesada–Rancho Los Patos, 395 m, 18 Nov 2000, *R. Cuevas 6910* (ZEA). **Mpio. El Grullo:** Arroyo El Colomo, 1000 m, 7 Nov 1988, *F. Santana M. & W. Anderson 4068* (ZEA). **Mpio. Puerto Vallarta:** cerca Fracc. Colinas Campestres, 150 m, 26 Aug 1990, *M, Cházaro B. & O. Montes 6405* (IEB, UCR). **Mpio. San Sebastián del Oeste:** 18 km WNW of San Sebastian, 410 m, 7 Jan 1990, *T.S. Cochrane et al. 12026* (IEB). **Mpio. Santa Maria del Oro:** Santa Maria del Oro, 900 m, 19 Dec 2005, *I. Garcia R. & M.C. Provance 7359* (CIMI, UCR). **Mpio. Tolimán:** 8–9 km adelante de Campo Cuatro, 1400 m, *R. Cuevas 4039* (ZEA). **Michoacan. Mpio. Aquila:** 3 km E de Aquila, 250 m, 29 Feb 1980, *B. Guerrero C. 742* (XAL). **Mpio. La Huacana:** Limón del Jorullo, 690 m, 15 Jun 2002, *X. Madrigal S. & S. Ontivaros A. 4803* (EBUM). **Mpio. Los Reyes/Periban (Jalisco):** Chorros del Varal, 950–1000 m, 30 Jun 2005, *I. García et al. 7122* (CIMI, UCR); Puente de Iturria, 28 Jun 2004, *M.C. Provance et al. 9398* (UCR). **Morelos. Mpio. Tepalcingo de Hidalgo:** 1 km SE de El Limón, 1310 m, 25 Feb 1991, *J. Bonilla 1434* (IEB, UCR).

1b. Diospyros acapulcensis Kunth subsp. **chiquimulensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov. (**Figs. 6, 19a–b**). Type: GUATEMALA. Chiquimula: "Frecuente a la entrada de Chiquimula," [ca. 14°48'N, 89°33'W], "100 m" [probably 400–1000 m], 20 May 1963, *A. Molina R. & A.R. Molina 12473* (holotype: F-1622586!).

Arbores a *Diospyros acapulcensi* ssp. *acapulcensi* similis sed differt laminis foliorum majoribus tenuioribus, infra strigosis trichomatibus rectis adpressis apicem versus, inflorescentiis floribus staminatis et pistillatis, calycis pistillatis intus ac tubis corollarum pistillatarum extus dense strigosis trichomatibus rectis horizontalibus, et antheris flavis erythrostictis differt.

Trees 4–5 m tall; **trunk** unknown; **stems** glabrous to sparsely hairy, the young stems sparsely hairy, the hairs apically curved to slightly wavy and subappressed, clavate glandular hairs present. **Petioles** minutely winged, 4 mm long, glandular-viscid, appressed to subappressed-puberulent below, sparsely ascending-puberulent above. **Lamina** membranaceous to subchartaceous, 80–103 mm long, 25–35 mm wide, length to width ratio 3–4 : 1, oblanceolate, *base* acute to narrowly cuneate, decurrent on the petiole, *margin* ± flat, ciliate, *apex* narrowly acute to narrowly acuminate; **lower lamina surface** sparsely to moderately appressed-pubescent, clavate glandular hairs also present, especially basally, the epidermis light brown, the stomatal apparatus translucent and inconspicuous; **upper lamina surface** glabrate, clavate glandular hairs sometimes present, the epidermis dark brown, densely papillate, somewhat tented. **Venation** brochidodromous; **midrib** subprominent below, with scant minute, appressed hairs, sparsely and minutely hairy above, sometimes with deltoid scales, glandular-viscid; **lateral veins** 9–12 per side, fine below, slightly raised above; **3°–4° veins** darkened below, inconspicuous above. **Male inflorescences** 3–4(–7)-flowered cymes (terminated by a female flower), densely minutely hairy; **peduncles** 2.5–3.5 mm long; **pedicels** 1–2 mm long, bracts lance-ovate, 2–2.5 mm long, navicular. **Male flowering calyx** finely subappressed wavy-hairy outside, epidermis dark brown, viscidulous, *tube* 3 mm long, 3 mm wide, often keeled from sinus to base, mostly glabrous inside, *lobes* ovate, 3.5–4 mm long, 4 mm wide, slightly winged, acuminate to a point, glandular, mostly sericeous inside; **male corolla tube** 2.8 mm long, 2 mm wide, thick-walled, exterior base with three glabrous shield-shaped zones, upper 1/2 densely buff sericeous; **male corolla lobes** (immature) thick, lanceolate, 1.5 mm long, 1 mm wide. **Stamens** 12; **filaments** adnate to the corolla towards the base, but at unequal levels, 1 mm long, sometimes geminate, *connective* red; **anthers** lanceolate to lance-acuminate, 1.5–2 mm long, yellow with minute red dots. **Female inflorescences** solitary flowers (those seen somewhat immature), or terminal flowers in otherwise male inflorescences, bracts lanceolate, up to 2.5 mm long, ± keeled. **Female flowering calyx** densely hairy outside, the hairs minute, slightly wavy, golden, *tube* 4 mm long, 3.5 mm wide, very thick, especially near the base, glabrous inside near the base, otherwise densely straight-hairy,

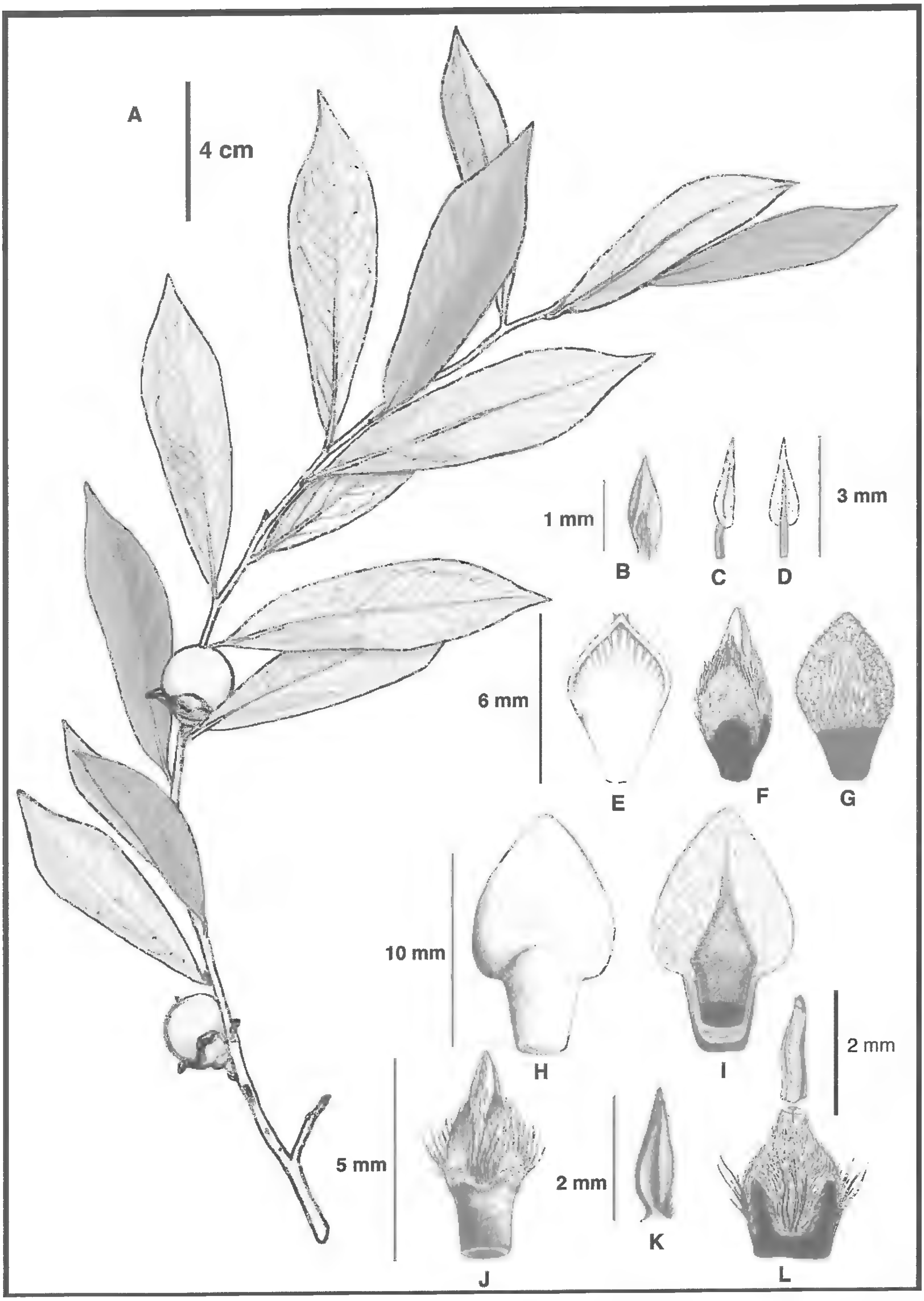


Fig. 6. *Diospyros acapulcensis* Kunth subsp. *chiquimulensis* M.C. Provance, I. García & A.C. Sanders, subsp. nov. Based on the holotype (*A. Molina R. & A.R. Molina 12473,* F-1622586). **A.** Fruiting branchlet. **B.** Male corolla lobe (abaxial side). **C.** Stamen (lateral view). **D.** Stamen (adaxial view). **E.** Immature male flower. **F.** Immature male corolla. **G.** Adaxial surface of immature male flowering calyx. **H.** Abaxial surface of immature female flowering calyx. **I.** Adaxial surface of immature female flowering calyx. **J.** Immature female corolla. **K.** Female corolla lobe (adaxial side). **L.** Pistil.

these horizontally oriented, reddish-gold, *lobes* 8.5 mm long, 7.5 mm wide, intramarginal band relatively wide, hairs golden, median hairs horizontally and distally oriented, the epidermis dark; **female corolla tube** 6–7 mm long, exterior lower 1/2 glabrous, upper 1/2 with three evenly spaced sericeous areas, the hairs of the intervening regions minute, horizontally oriented, upper and lower-halves separated by an undulate ring of minute retrorse hairs, epidermis dark reddish-brown; **female corolla lobes** lanceolate, 2–2.3 mm long, 1 mm wide; **ovary** subglobose, 2 mm long, 1.5 mm wide, minutely cream sericeous, with clusters of longer hairs from the base, three shield-shaped glabrous zones also present around the base; **styles** 3, fused into a 1.5 mm long column, minutely hairy; **stigmas** unknown (damaged); **staminodes** 3, lanceolate, adnate to the corolla. **Fruiting pedicels** stout, ± 3 mm long, densely hairy. **Fruiting calyx** campanulate to infundibuliform, similar outside to the flowering calyx, *tube* 5–6 mm long, bulbous at the base, *lobes* obtuse, 7–7.5 mm long, 11 mm wide, reflexed near the apex. **Fruit** (probably immature) ± 1.5 cm diameter, moderately hairy, the hairs minute, subappressed, nearly straight, gold, epidermis glaucous-pruinose, light golden brown. **Seeds** unknown.

This taxon is notable for male flowering cymes terminated by female flowers; its large, thin, leaves with acuminate apices coming to distinct points; horizontal hairs on the inside of the female calyx and the outside of the female corolla tube; and yellow anthers with red dots. Further study may reveal that this taxon warrants species rank, but we are following a conservative course in placing it at the subspecific level, because we've only seen a single specimen. Of related taxa, it is most similar to *D. a.* subsp. *veraecrucis*. The single collection was made near Chiquimula, Guatemala, at an elevation of "100 m" (Figs. 23, 24). The reported elevation is likely a typographical error for 1000 m, as the lowest elevation in the area is 400 m. This species is named for the Department of Chiquimula, Guatemala, where the type specimen was collected.

1c. Diospyros acapulcensis Kunth subsp. **dwyeri** M.C. Provance, I. García & A.C. Sanders, subsp. nov. (**Figs. 7, 21c**). Type: PANAMA. Panama: Canal Zone, Farfan Beach, road along beach, [8°56'N, 79°35'W, 1–5m], 3 Aug 1967, *J.D. Dwyer & S.M.V. Hayden 7525* (holotype: MO-2067635!; isotypes: MO-2129488!, F! online image, UC, COL, "Moldenke" [probably at LL]).

Frutices a *Diospyros acapulcensi* ssp. *acapulcensi* similis sed differt petiolis fructiferis longioribus, lobis calycibus angustioribus, et laminis foliorum amplioribus quoad rationi longitudo-latitudo infra strigosis trichomatibus rectis adpressis apicem versus.

Shrubs to 4.5 m tall; **trunk** unknown; **stems** glabrous when mature, young stems sparsely upright to subappressed-villous and densely covered in shorter upright to ascending, curved to kinked, yellowish to golden-brown hairs, the epidermis glistening, brownish mottled. **Petioles** minutely winged, 4–5 mm long, yellowish, hairy below, densely and conspicuously yellowish hirsutulous to pubescent above. **Lamina** subchartaceous to chartaceous, 60–70(–80) mm long, 15–20 mm wide, length to width ratio 3.2–4 : 1, oblanceolate, *base* cuneate to narrowly acute, decurrent on the petiole, *margin* flat to minutely revolute, *apex* narrowly acuminate with a blunt point; **lower lamina surface** sparsely ± appressed-pubescent, the hairs 0.5–1.5 mm long, densest near the margin, clavate glandular hairs present, the epidermis tan to light greenish-brown, the stomatal apparatus translucent and inconspicuous; **upper lamina surface** sparsely puberulent, the epidermis brownish-green, even to vaguely tented, densely crystal-papillose. **Venation** arcolanguid; **midrib** prominent below, subappressed to appressed puberulent, the hairs mostly > 1 mm, yellowish, clavate glandular hairs present, on the upper surface flush to slightly raised, puberulent to short wavy-hairy, the epidermis yellowish; **lateral veins** 6–8 per side, yellowish, prominent below, apparent above; **3°–4° veins** fine and barely raised below, sometimes darkened, inconspicuous above. **Male inflorescences and flowers** unknown. **Female inflorescences and flowers** unknown, except **style remnants** on immature fruit columnar, ± 3 mm long, minutely hairy. **Fruiting pedicels** slender, 6–8 mm long, bracts narrowly oblong, minute, concave to navicular. **Fruiting calyx** densely hairy outside, the hairs minute, wavy, subappressed to ascending, reddish-gold, epidermis dark, *tube* half-globose, 4–6 mm long, sparsely golden sericeous inside, *lobes* spreading, rounded, 4–5 mm long, 7–9 mm wide, acuminate to an obscure point, interior mostly reddish-gold sericeous, golden tomentulose at the intramargin. **Fruit** (immature) globose, the hairs straight to curved, 0.1–0.5 mm long, appressed to subappressed except basally where straight, fine, ± 1 mm long, epidermis dark reddish-brown. **Seeds** unknown.

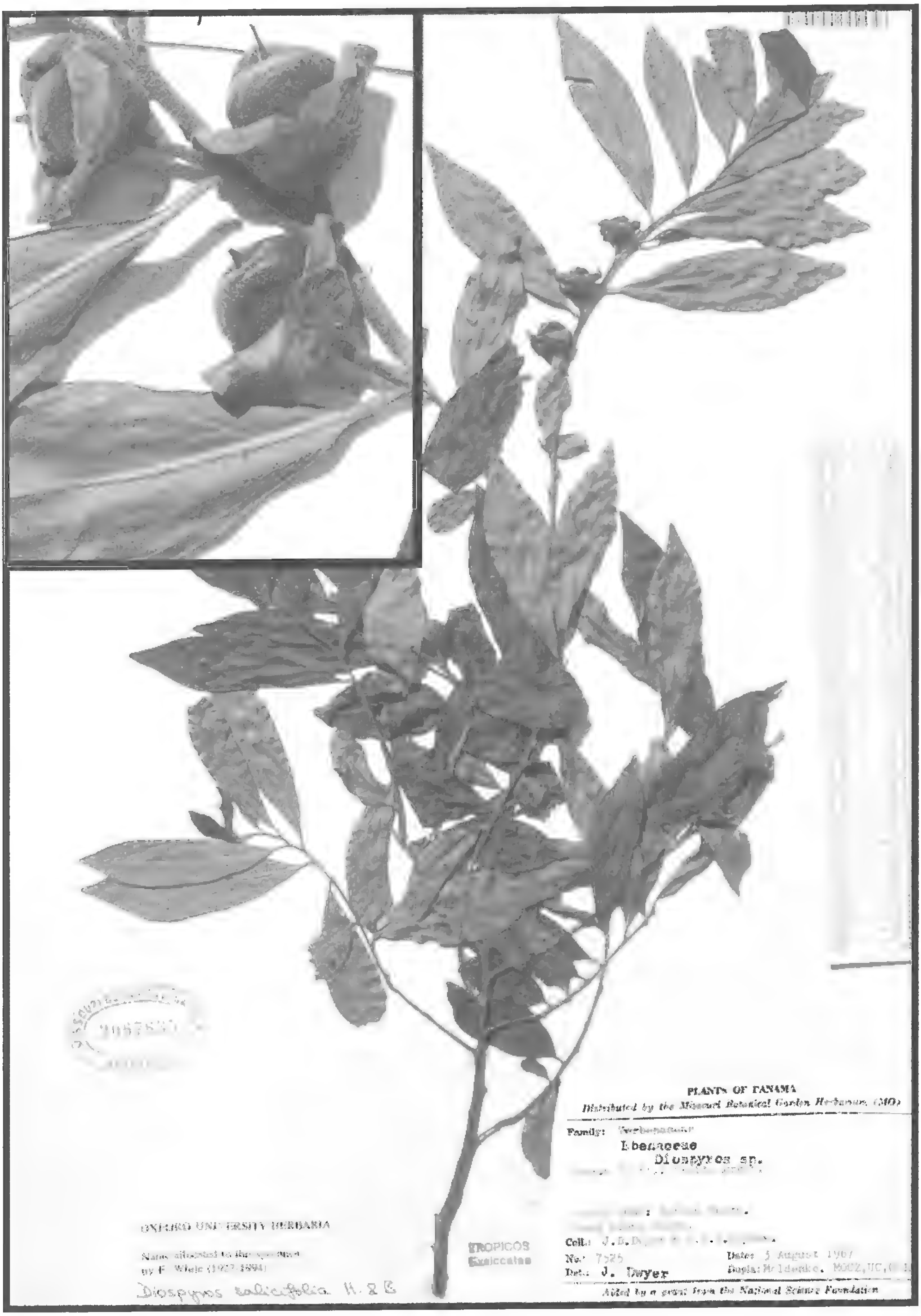

PLANTS OF PANAMA
Distributed by the Missouri Botanical Garden Herbarium (MO)
Family:
Ebenaceae
Diospyros sp.
Coll.: J. D. D
No.: 7525
Date: 5 August 1967
Det.: J. Dwyer
Aided by a grant from the National Science Foundation
OXFORD UNIVERSITY HERBARIA
Diospyros salicifolia H. & B.
TROPICOS
Exsiccatae

Fig. 7. Holotype of *D. acapulcensis* Kunth subsp. *dwyeri* M.C. Provance, I. García & A.C. Sanders, subsp. nov. (*J.D. Dwyer & S.M.V. Hayden 7525*, MO-2067635).

This subspecies seems endemic to Panama, the only collection seen being from Farfan Beach, near the Pacific entrance to the Panama Canal (Fig. 24). Vegetation mapped in this area includes semideciduous forest and periodically inundated tree savanna with a grassy herb layer (ANAM and CBMAP 2000). There may also be patches of swamp forests in the vicinity. Unseen collections of '*Diospyros salicifolia*' cited for Panama (White 1978, D'Arcy 1987) may represent this subspecies, and include a collection from Cativo Swamp, Darien Province (*Duke 11739a*). This taxon is easily separated from *D. a.* subsp. *veraecrucis* by its much longer fruiting pedicels, and from subsp. *D. a.* subsp. *rivensis* by its shorter, narrower lamina, that is especially narrower relative to width at 3/4 length, and calyx tube that is narrower relative to width as well. This subspecies is named in honor of the late John Dwyer, collector of the type specimen and renowned plant taxonomist, ethnobotanist, professor at Saint Louis University, and research associate of the Missouri Botanical Garden.

1d. Diospyros acapulcensis Kunth subsp. **guanacastensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov. **(Figs. 8, 20a–b)**. TYPE: COSTA RICA. GUANACASTE: Parque Nacional Palo Verde, Sector Catalina, Camino y Sendero Botija Saliendo al Campo de aterrizaje del Refugio Palo Verde, 10°21'N, 85°21'W, 20 m, 26 Nov 1991, *U. Chavarría 427* (HOLOTYPE: MO-5700632!; ISOTYPE: INB).

Arbores a *Diospyros acapulcensi* ssp. *acapulcensi* similis sed differt fructibus fuscatis, calycibus fructiferis extus viscidissimus vestimento atroferrugineo ac rubri-aureo.

Trees 2–10 m tall; **trunk** to 30 cm in diameter, whitish to grayish-white; **stems** glabrous or with ashy remnants of hairs when mature, densely hairy when young, the hairs ascending to upright, bright reddish-orange to brownish, the epidermis shiny and viscid. **Petioles** 4–7 mm long, rugose, viscid and shiny, brick red to dark reddish-brown, densely pubescent below, the hairs bright, blond to reddish-gold, shorter above. **Lamina** chartaceous, 45–85(–95) mm long, 20–35 mm wide, length to width ratio (1.8–)2–2.8 **:** 1, oblanceolate to obovate or oblong-ovate, sometimes nearly elliptic, *base* acute to obtuse, abruptly decurrent on the petiole, *margin* flat to minutely revolute, sometimes ciliate, *apex* acute to obtuse; **lower lamina surface** ascending-pubescent, the hairs golden to ferruginous, clavate glandular hairs often present, the epidermis dark reddish-brown and sometimes black-mottled, the stomatal apparatus translucent and inconspicuous; **upper lamina surface** densely wavy-hairy, the hairs deciduous, leaving seeping annular papillae, clavate glandular hairs often present, deciduous, leaving the epidermis viscid, the epidermis dark, often tented, crystal-papillose. **Venation** eucamptodromous, viscid, prominent below, often 3-ribbed from the base; **midrib** rugulose below, densely hairy, the long ascending to spreading hairs sometimes sticking to the epidermis, midrib impressed above and wavy-hairy; **lateral veins** 6–9 per side; **3° veins** on lower surface similar to the midrib below. **Male inflorescences** 3–5-flowered cymes, partly ascending-pubescent, partly tomentulose; **peduncles** 1–2 mm long; **pedicels** 1–2 mm long, bracts lance-ovate, 1.5–2.5 mm long, navicular. **Male flowering calyx** glabrous inside except for a very narrow intramarginal band on the lobes, exterior partly wavy subappressed to ascending-pubescent, partly tomentulose, the epidermis viscid, dark brown, *tube* 3.5 mm long, 3 mm wide, sometimes vaguely keeled from the sinus to the base, *lobes* acute, 2–2.5 mm long, 2 mm wide; **male corolla tube** 6 mm long, 2 mm wide, sericeous except for 3 basal shield-shaped glabrous zones, ± 1.5 mm long, these minutely puberulent distally; **male corolla lobes** ovate to elliptic, 3 mm long, 1 mm wide. **Stamens** 12; **filaments** adnate to the base of the corolla, a few sometimes inserted on the receptacle, 1.5–2 mm long, sometimes geminate, red; **anthers** lanceolate, 2 mm long, aristate. **Female inflorescences and flowers** unknown except **styles remnants on immature fruit** columnar, hairy, 3 in number. **Fruiting pedicels** stout, 0.5–2.5(–5) mm long, fissured to shallowly grooved, sparsely to densely hairy, the hairs reddish-gold, bracts ovate to deltoid and sharply pointed, 1.2–1.6 mm long, flat to vaguely concave. **Fruiting calyx** semi-globose when immature, explanate and torn at the sinuses when mature, densely hairy outside, in part tomentulose, in partly villous, the hairs tawny to brilliant reddish-gold, ± deciduous, the epidermis dark brown, shiny and viscid, *tube* 6–10 mm long, without a bulbous base, the upper 1/2 densely hairy inside, the lower 1/2 glabrate, *lobes* obtuse, 3.5–7.5 mm long, 9.5–13 mm wide, barely acuminate to a point, usually reflexed, densely hairy inside with wide intramarginal band, the hairs

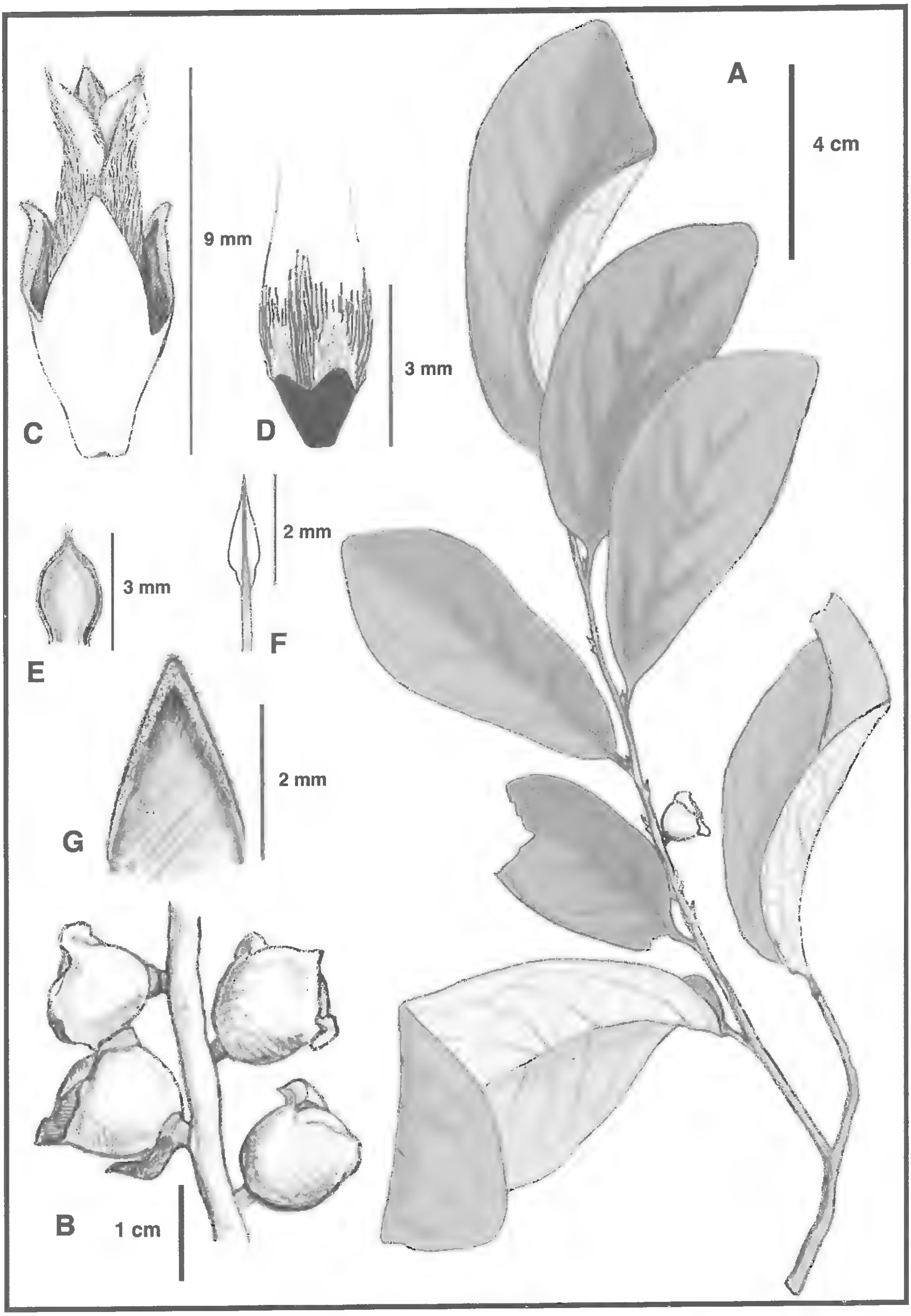


Fig. 8. *Diospyros acapulcensis* Kunth subsp. *guanacastensis* M.C. Provance, I. García & A.C. Sanders, subsp. nov. A–B. Based on the holotype (*U. Chavarría 427*, MO-5700632). A. Branchlet with calyx of immature fruit. B. Immature fruiting calices. C–G. *A.M. Brenes 15605* (BH). C. Male flower. D. Male corolla tube (proximal half). E. Male corolla lobe (adaxial side). F. Stamen. G. Adaxial surface of male calyx lobe.

tawny. **Fruit** 1.5–2(–2.3) cm in diameter, gold to reddish-brown ascending-velutinous until nearly mature, then glabrate, glaucous-pruinose, sometimes minutely gland-dotted, reportedly green (when mature) to orange-brown (presumably when fully ripe) in life, epidermis brownish, and sometimes quite dark, in herbarium specimens. **Seeds** 14 mm long, 6 mm radial depth, 4 mm wide.

This subspecies is geographically isolated from both *D. a.* subsp. *nicaraguensis* and *D. a.* subsp. *pedromorenoi* in Nicaragua, being endemic to dry tropical forest near sea level to 800 m in NW and central Costa Rica (Fig. 24). In NW Costa Rica it has been collected on the Nicoya Peninsula at Barra Honda National Park, the Island of San Lucas, and the southern slopes of the Cordillera de Guanacaste at Rincón de la Vieja National Park. Other sites include the vicinities of Bagaces, Cañas, and Palo Verde National Park. The NW limit of this subspecies appears to be Santa Rosa National Park. Material intermediate with *D. a.* subsp. *rivensis* has been collected on Cerro El Hacha at 1100 m. Collections from near sea level at the SE extreme of the Nicoya Peninsula, and from the margins of the Candelaria River in central Costa Rica are difficult to place, and may be intermediates with *D. a.* subsp. *rivensis*. Some specimens from the Department of Guanacaste have rather distinctive leaves and fruiting calyces (as seen in the type) that are very viscid, have a dark reddish-brown epidermis, and a brilliant reddish-gold vestiture. Annular glands on both leaf surfaces are derived from deciduous hairs that have left the basal portion of the fluid-filled trichome and/or the swollen region of the epidermis at the base of the trichome. These are particularly conspicuous in collections from Palo Verde National Park and San Lucas Island. This subspecies differs from *D. a.* subsp. *nicaraguensis* in its longer fruiting calyx tube, shorter distance between superadjacent lateral veins, intense golden to reddish-brown vestiture and dark fruits. Compared to *D. a.* subsp. *pedromorenoi*, this subspecies has smaller fruits, shorter fruiting pedicels, a longer fruiting calyx tube, and different stem, inflorescence, and abaxial lamina vestiture.

Representative specimens. **COSTA RICA. ALAJUELA:** entre Bagaces y Los Cañas, 29 May 1932, *A.M. Brenes 15605* (BH). **GUANACASTE:** P.N. Rincón de la Vieja, 700–800 m, 16 Oct 1990, *Gerardo Rivera 780* MO); P.N. Palo Verde, 10–150 m, 9 Jan 1992, *U. Chavarría 475* (BM); near Bagaces, 50 m, 26 Apr 1972, *P.A. Opler 761* (MO); 15 km S of Liberia, 170 m, 4 Jul 1971, *W.E. Harmon & J.A. Fuentes 6068* (UMO); Hacienda La Pacifica, near Cañas, 19 Aug 1985, *D.S. Seigler DS-12401* (MO, ILL), same location, 14 Aug 1986, *D.S. Seigler DS-12782* (MO, ILL); Llanos de Cortes, 24 Jan 1984, *T.D. Pennington & L.J. Poveda 11420* (MO); P.N. Rincón de la Vieja, Est. Las Pailas, 800 m, 3 Nov 1993, *R. Espinoza 618* (MO); Santa Rosa N.P., towards Quebrada de Costa Rica, 100 m, 25 Jan 1983 *Garwood et al. 516* (MO); P.N. Santa Rosa, Bahía Salinas a Santa Cecilia, 300 m, 14 Jul 1994, *R. Espinoza 1119* (MO); Cantón de Nicoya, P.N. Barra Honda, 300—400 m, 9 Jun 1993, *Reyes 164* (MO); Est. Biol. Palo Verde, 20–90 m, 20 Dec 1992, *Quigley 931* (LSU); Tempisque, Est. Biol. Palo Verde, 10–100 m, 12 Dec 1990, *U. Chavarría 199* (MO); Ferri del Tempisque del lado de Cañas, 28 Aug 1985, *Poveda et al. 4023* (VT). **PUNTARENAS:** Isla San Lucas, 0 m, 29 Aug 1985, *N. Zamora V. 1087* (MO, VT); Cantón de Puntarenas Monteverde, Río Guacimal, 600-800 m, 7 Aug 1992, *W. Haber et al. 11326* (BM).

1e. Diospyros acapulcensis Kunth subsp. **mejocotensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov. **(Figs. 9, 21a–b)**. TYPE: HONDURAS. LEMPIRA: Río Mejocote, 9 km de Gracias, [14°32'N, 88°31'W], 1000 m, 7–9 Dec 1971, *C. Nelson, M. Hernández & A. Rosales 184* (HOLOTYPE: MO-4594757!; ISOTYPE: TEFH-3807!).

Arbores a *Diospyros acapulcensi* ssp. *acapulcensi* similis sed differt laminis foliorum obtrullatis latioribus, praesertim ad 3/4 longitudinem, infra viscidis atroferrugineis, fructibus paene sessilibus, et pedicellis fructiferis ebracteatis.

Trees 6 m tall; **trunk** unknown; **stems** glabrous when mature, the young stems densely hairy, the hairs mostly 0.2–0.6 mm long, slightly wavy, ascending to upright, colorless to reddish-brown, the epidermis viscid, dark reddish-brown. **Petioles** 4–6 mm long, rugose, the epidermis very viscid, golden-brown, hairy below with wavy to straight glossy hairs, these subappressed. **Lamina** chartaceous, 80–119 mm long, 35–54 mm wide (40–50 mm at 3/4 length), length to width ratio 1.9–2.5 : 1, obovate to obtrullate, *base* acute, decurrent on the petiole, *margin* flat, *apex* obtusely-acuminate; **lower lamina surface** densely hairy when young, the hairs curly to slightly wavy, clear to reddish-brown, glabrate when mature, the bases of the hairs slightly swollen, leaving glandular annular papillae upon loss of the hairs; **upper lamina surface** initially densely ascending wavy-hairy, also with some clavate glandular hairs, but mature leaves glabrate. **Venation** arcolanguid to eucamptodromous, the epidermis viscid, reddish-brown; **midrib** prominent below and at the base on the upper surface, vestiture similar to petiole; **lateral veins** 7–8 per side, finely raised above,

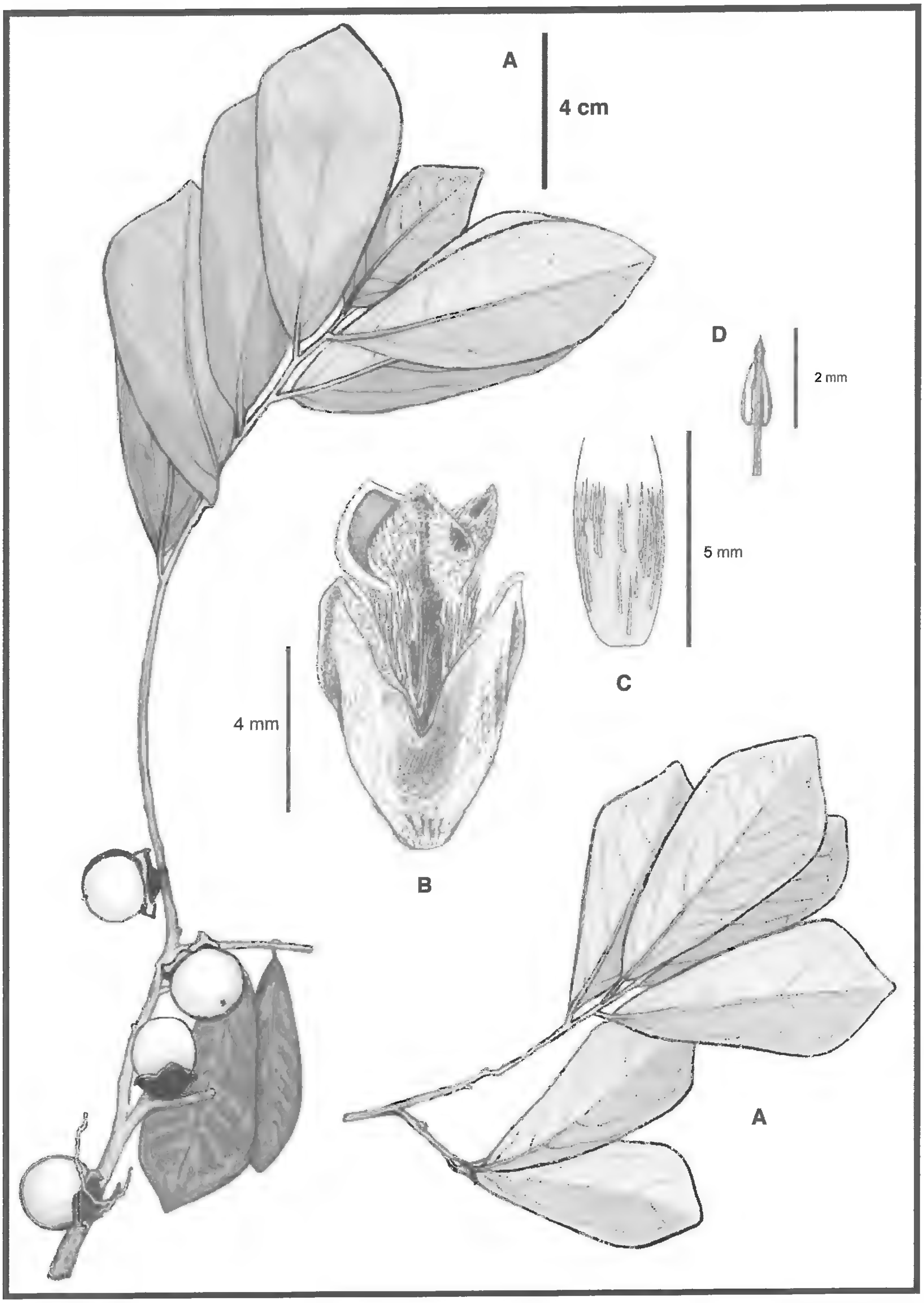


Fig. 9. *Diospyros acapulcensis* Kunth subsp. *mejocotensis* M.C. Provance, I. García & A.C. Sanders, subsp. nov. A. Fruiting and sterile branchlets, based on the holotype (*C. Nelson et al. 184,* MO-4594757). B–D. Based on *S. Blackmore & M. Chorley 3903* (TEFH). B. Male flower. C. Male corolla tube (proximal portion). D. Stamen.

impressed along the midrib-lamina seam; **3° venation** barely raised above and below. **Male inflorescences** 3(–6)-flowered cymes, pubescence similar to young stems; **peduncles** 2.5–4 mm long; **pedicels** 1–2 mm long, bracts 1.8 mm long, narrowly elliptic, navicular. **Male flowering calyx** glabrous inside, minutely reddish-brown kinky-hairy outside, with scattered short crooked ascending hairs, the epidermis viscid, dark reddish-brown, *tube* 3 mm long, 3 mm wide, *lobes* acute, 4 mm long, 3 mm wide, glabrate inside, with only a few straight appressed hairs near the apex and a narrow tomentulose intramarginal band, similar to the tube outside, but the hairs sparser, sometimes subappressed; **male corolla tube** 5 mm long, 2 mm wide, tawny to golden brown sericeous outside, except for 3 glabrous regions at the base, these sometimes continuing onto the petal lobe (the hairs apparently readily deciduous), the epidermis dark reddish-brown; **male corolla lobes** rhombic, strongly involute on one or both sides, 2.8 mm long, 2.8 mm wide. **Stamens** 12; **filaments** adnate to the corolla at or near the base, 1.4 mm long, dark brown; **anthers** lanceolate, 1.7–2.0 mm long, rigidly pointed, golden brown. **Female inflorescences and flowers** unknown. **Fruiting pedicels** stout, 0.3–1 mm long, bracts 0. **Fruiting calyx** campanulate, glabrate to sparsely hairy outside, sometimes with desiccated hairs stuck to the viscid, horizontally wrinkled, very dark epidermis, *tube* 7–8 mm long, base not bulbous, minutely tawny sericeous almost completely to the base, *lobes* widely obtuse, 5–6 mm long, 12–13 mm wide, vaguely acuminate to a blunt point, reflexed, tawny sericeous inside except for a broad tomentulose intramarginal band. **Fruit** globose to subglobose, 2 cm in diameter, densely subappressed golden puberulent near the apex, otherwise glabrate, epidermis glaucous-pruinose, slightly scintillant, mauve, orange-brown where the cuticular wax has been removed. **Seeds** 13 mm long, 6 mm radial depth, 3.5 mm wide.

This taxon is similar to *D. a.* subsp. *pedromorenoi*, but has nearly sessile fruit and obtrullate leaves. The fruiting calyces are similar to those of *D. a.* subsp. *veraecrucis*, but the leaves are differently shaped and have kinky to curly, upright, reddish hairs abaxially in contrast to the straight, appressed, distally-directed hairs of *D. a.* subsp. *veraecrucis*.

This subspecies has been collected twice in the Mejocote River Valley in southwestern Honduras, just E and NE of the Cordillera de Celaque (Figs. 23, 24); once in pine forests at 1000 m, and again along a tributary of the Mejocote River at about 750 m, ± 20 km NNW of this site, from "rocky cliffs over large river" (*S. Blackmore & M. Chorley 3903*). The known collections of this taxon come from places near Celaque National Park, and so it should be sought within the park boundaries along arroyos and watercourses at lower elevations.

Specimens examined. **HONDURAS. Lempira:** near Las Flores, on road Santa Rosa de Copán–Gracias [14°42'N, 88°36'W, 752 m], 13 May 1987, *S. Blackmore & M. Chorley 3903* (TEFH, BM not seen).

1f. Diospyros acapulcensis Kunth subsp. **nicaraguensis** (Standl.). M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov. (**Figs. 10, 11, 18a–e**). Basionym: *Maba nicaraguensis* Standl. Contr. U.S. Natl. Herb. 20:193. 1919. *Diospyros nicaraguensis* (Standl.) Standl. Publ. Carnegie Inst. Wash. 461: 80. 1935. Type: NICARAGUA. Granada: 16 Feb 1906, *C.F. Baker 629* (holotype: US-862725 as microfiche UCSB!).

Maba nicaraguensis Standl. J. Wash. Acad. Sci. 17:526. 1927. nom. superf. Type: NICARGUA: near Managua, 16 Apr 1926, *D. Chavez 206* (holotype: US-1266111).

Trees and shrubs, 1–12(–20) m tall; **trunk** up to 30 cm in diameter, sometimes with multiple trunks, bark smooth, grayish to reddish-brown; **stems** sometimes with scant persisting hairs when mature, young stems pilose to villous, sometimes sublanate, the hairs blond to dull orange, sometimes also partly retrorse hirsutulous, with clavate glandular hairs often present, but deciduous, as a result the epidermis viscid, often mottled with black shiny regions. **Petioles** narrowly edged, (3–)3.5–6.5(–8) mm long, epidermis rugose, viscid, becoming glabrous, but initially densely hairy above and below, the hairs wavy to straight and ascending to retrorse, clavate glandular hairs often present. **Lamina** membranaceous in spring, later chartaceous, 50–120(–140) mm long, (20–)28–47(–65) mm wide, length to width ratio (1.7–)1.8–2.7(–3.3) : 1, elliptic to obovate-elliptic or oblanceolate-elliptic, *base* obtusely to acutely attenuate, decurrent on the petiole, *margin* flat to minutely revolute, *apex* acute to rounded, sometimes acuminate; **lower lamina surface** moderately to

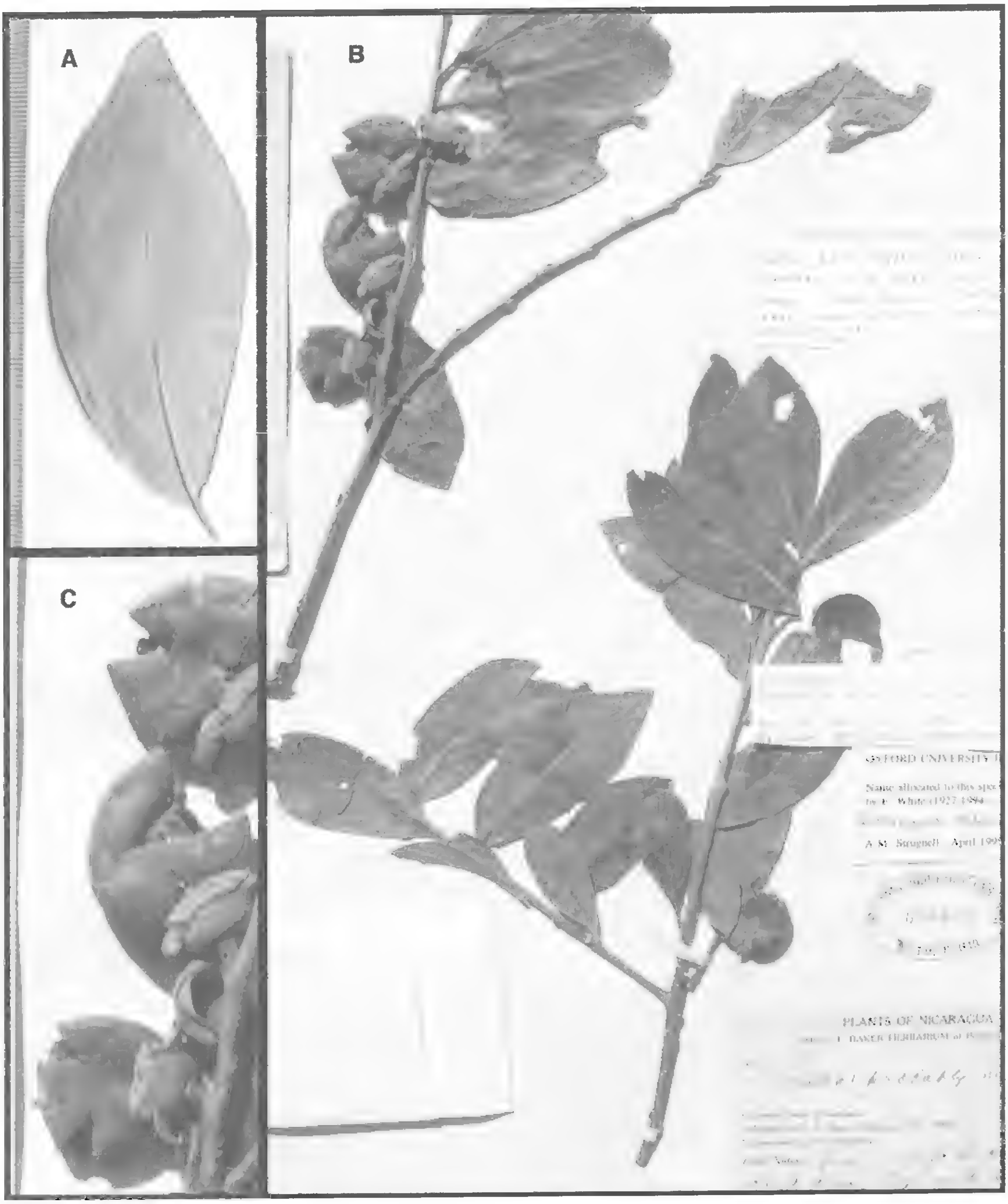


Fig. 10. *Diospyros acapulcensis* Kunth subsp. *nicaraguensis* from Granada, Dept. of Granada, Nicaragua. A. Abaxial leaf surface (*C.F. Baker 157*, ARIZ). B–C. (*C.F. Baker 157*, MO). B. Fruiting and sterile branchlets. C. Detail of fruiting branchlet.

densely hairy, the hairs straight to wavy, ascending to upright, yellowish to dull orange, clavate glandular hairs often present, but deciduous, epidermis brownish-green, the stomatal apparatus translucent to opaque, often conspicuous; **upper lamina surface** villous, clavate glandular hairs often present, but deciduous, epidermis dark grayish-green, sometimes crystal-papillose. **Venation** eucamptodromous; **midrib** prominent below, hirsute, especially along the sides, some hairs slightly wavy, hairs curly to straight above, mostly upright,

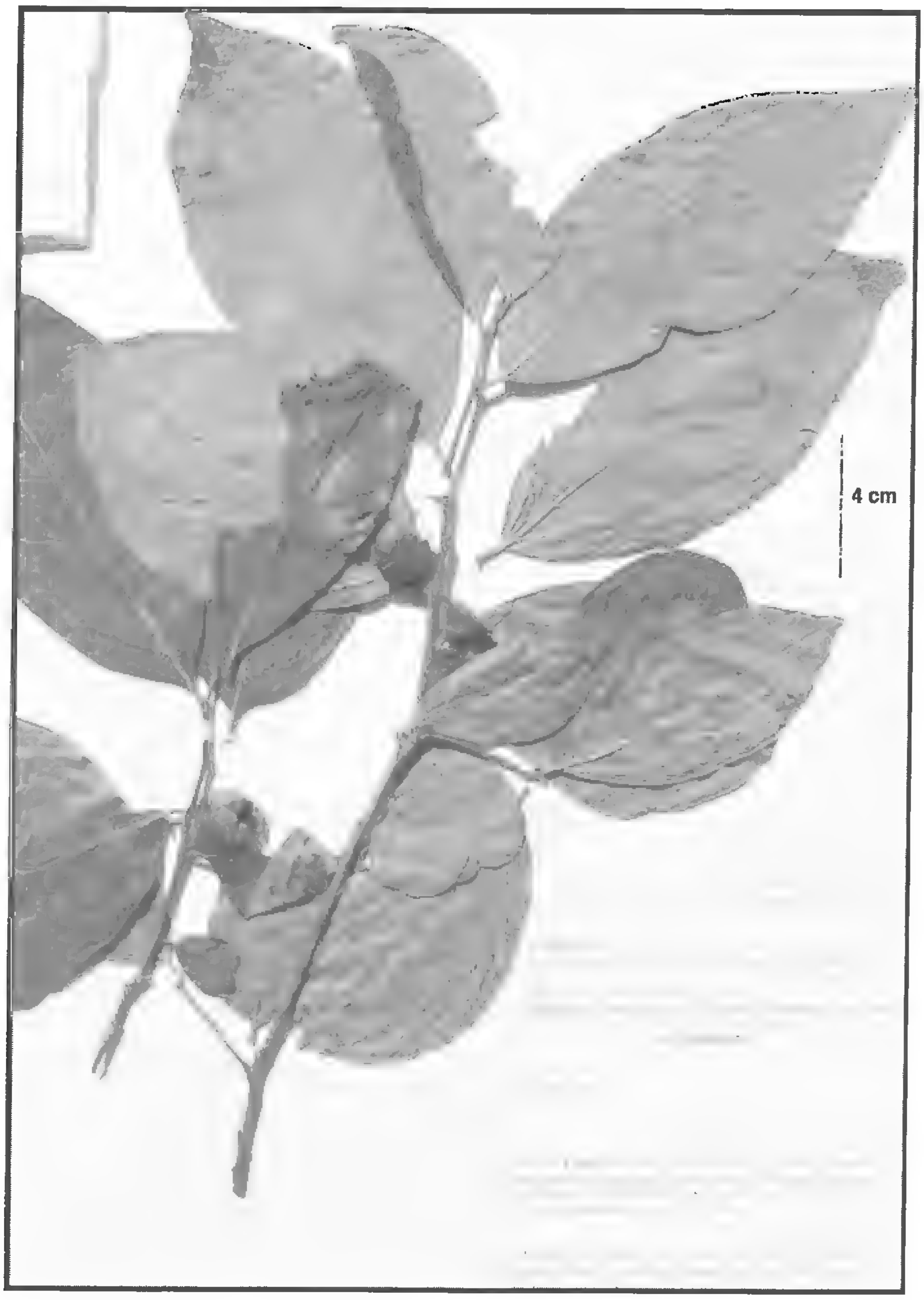


Fig. 11. *Diospyros acapulcensis* subsp. *nicaraguensis* from 13.5 km W of Juigalpa, Dept. of Chontales, Nicaragua (*M. Nee 27612,* MO).

but ascending to retrorse basally; **lateral veins** (5–)7–10(–12) per side, prominent below, raised above; **3° veins** prominent below, usually raised above; **4° veins** barely raised below, sometimes darkened in young leaves. **Male inflorescences** 1–3-flowered cymes, densely minutely wavy-hairy; **peduncles** (3–)4–6 mm long; **pedicels** 1.5–2 mm long, bracts lanceolate, 1.5 mm long. **Male flowering calyx** densely tomentulose outside, the epidermis viscid, dark brown; *tube* 2.5–4 mm long, 3–4.5 mm wide, glabrous inside, *lobes* acute, 3.5–6 mm long, 2–4 mm wide, bluntly pointed, sericeous inside except for a narrow intramarginal band; **male corolla tube** 5–7 mm long, 2–3 mm wide, cream to pinkish sericeous outside, with 3-4 shield-shaped glabrous basal regions, glabrous and sericeous areas sometimes separated by a few minute retrorse hairs; **male corolla lobes** white, cream, yellow, or red (reportedly, perhaps in error), lanceolate, ovate or rhombic, 2–4 mm long, 1–2 mm wide. **Stamens** 12; **filaments** adnate to the corolla at or near the base of the tube, sometimes inserted on the receptacle, 0.8–1.5 mm long, sometimes geminate; **anthers** lanceolate to oblong, 1.5–2 mm long, apiculate to rostrate. **Female inflorescence** densely hairy, bracts 1–2, opposite or alternate, 1.6–2.5 mm long, lanceolate to broadly ovate, acuminate, slightly concave to navicular. **Female flowering calyx** sericeous inside, except glabrous basally and lobes with a broad tomentulose intramarginal band, densely and minutely wavy-hairy outside, *tube* cupulate, thickened, especially basally, 1.8–2 mm long, 5 mm wide, *lobes* obtuse, 5–6 mm long, 7.5–8 mm wide; **female corolla tube** 5.5 mm long, 3 mm wide, upper 1/2 sericeous outside, basal 1/2 with 3-4 shield-shaped glabrous areas, straight retrorse hairs sometimes separating the glabrous and sericeous regions; **female corolla lobes** ovate, lanceolate or rhombic, 3 mm long, 1.8–2 mm wide; **ovary** subglobose to depressed-globose, densely and minutely hairy; **styles** 3(–4), ± 1.3 mm long, partly fused, hairy; **stigmas** ± 0.8 mm long, minutely hairy; **staminodes** ± 6, adnate to base of corolla, filaments, 1.8 mm long, sterile anthers 1 mm long, lanceolate, asymmetric basally. **Fruiting pedicels** stout, (0.5–)1–5(–7) mm long, glabrate to densely hairy. **Fruiting calyx** subrotate to campanulate, densely hairy outside, sometimes glabrate, *tube* (3–)4.5–8(–9) mm long, base often bulbous, *lobes* obtuse, 3–6.5(–7.5) mm long, (7–)9–13(–16) mm wide, reflexed; **fruit** subglobose to depressed-globose, 1.5–2.5 cm in diameter, glaucous, scintillant, yellowish, orangish or light brown, living material reportedly orange when ripe. **Seeds** 14 mm long, 7 mm radial depth, 5 mm wide.

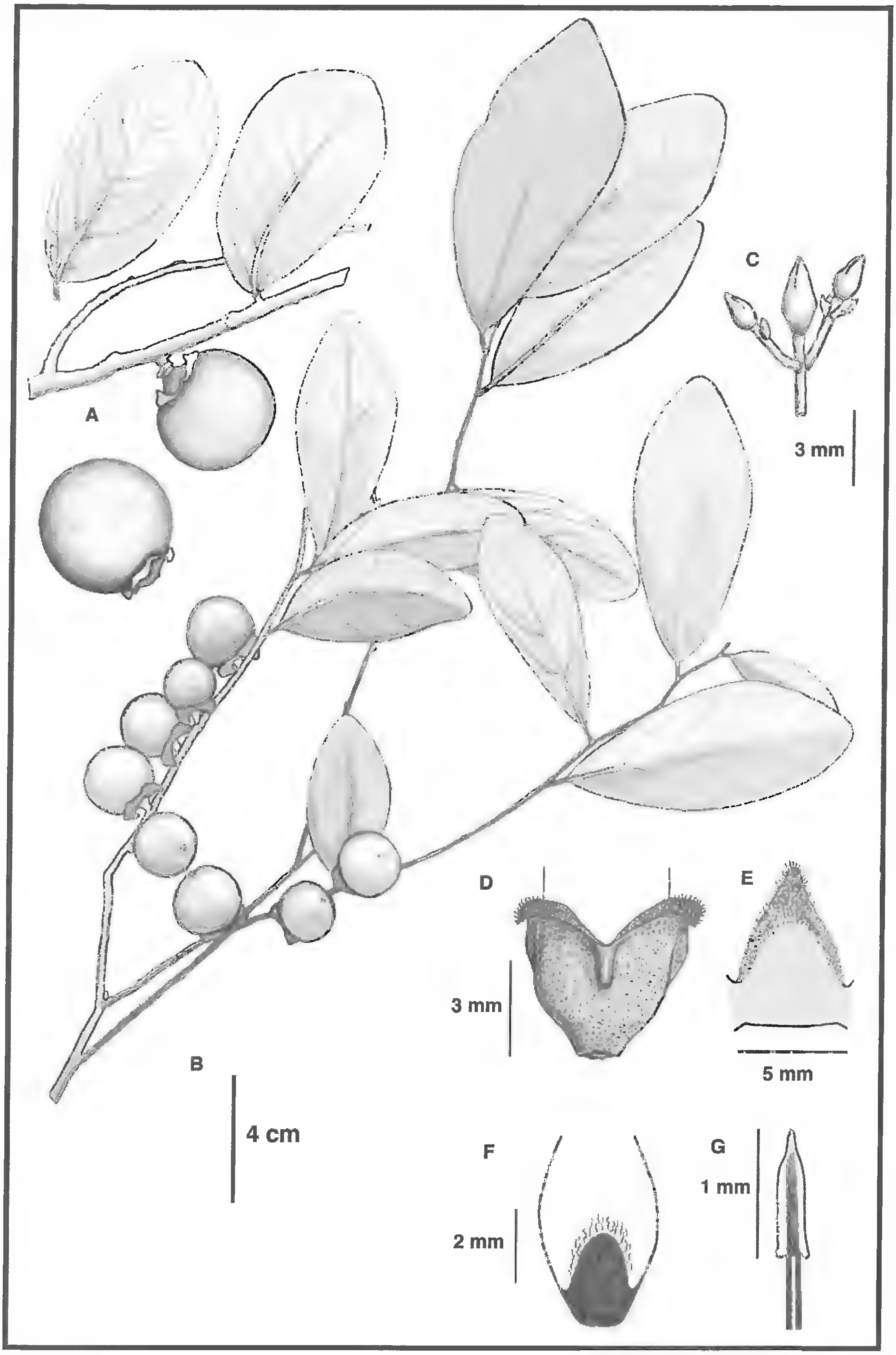
This subspecies is found from near sea level to 1500 m in a wide range of habitats, including tropical deciduous forest, semideciduous forest, and pine-oak forest, in the cordilleras of southern Nicaragua, Honduras, northeastern El Salvador, and eastern Guatemala (Figs. 23, 24). This taxon is most similar to *D. a.* subsp. *guanacastensis,* which has a longer fruiting calyx tube, and a gold to reddish-brown vestiture and dark fruits. It forms intermediates with *D. a.* subsp. *pedromorenoi* in several areas of west-central Nicaragua. Some collections from Isla Momotombito, Lake Managua, are difficult to place, and are tentatively regarded as intermediate with *D. a.* subsp. *rivensis*. The duplicates of *C.F. Baker 157* are considered isotypes by Wallnöfer (by annotation of the MO specimen in May 1999) because they "have the same label data!" However, in addition to differences in collection number, the holotype *C.F. Baker 629* (US) label reads "about dry hills," while the *C.F. Baker 157* collections (MO, ARIZ) do not. Moreover the labels are in different handwriting. Specimens of *C.F. Baker 157* (MO, ARIZ) bear Pomona College labels, while the holotype has the U.S. National Museum label. There seems to be insufficient reason to consider *C.F. Baker 157* collections isotypes.

Representative specimens. **EL SALVADOR. Morazán:** Perquín, Rio Sapo, 25 Jan 2000, *J. Monterrosa et al. 15* (MO). **San Miguel:** San Luis Reina, 9 Jan 1975, *J.R. Martinez 315* (TEFH). **GUATEMALA. Chiquimula:** Caracol Mountain, 1.5 mi N of Quezaltepeque, 1200–1400 m, 7 Nov 1939, *J.A. Steyermark 31396* (F). **Zacapa:** above Teculután, 250–275 m, 7 Jan 1942, *J.A. Steyermark 42132* (F). **HONDURAS. Choluteca:** Tatumbla, 25 km de la capital, 1500 m, 28 Sep 1982, *V.M. Pineda s.n.* (MO). **Comayagua:** Chichipates, *C. Nelson et al. 6746* (TEFH). **Cortés:** orilla del Río Humuya, 40 km N Santa Cruz de Yojoa, 100 m, 1–30 Nov 1980, *C. Nelson et al. 5752* (TEFH, MO). **El Paraíso:** near Casitas, 900 m, 4 Dec 1946, *L.O. Williams & A. Molina R. 11074* (MO). **Francisco Morazán:** slopes on Cerro Majicarán, 900 m, 14 Jun 1947, *A. Molina R. 108* (MO). **Intibuca:** Quebrada Los Naranjos, Aldea San Juan, Magdalena, 10 Jan 1975, *J.R. Martinez 347* (TEFH). **La Paz:** between Galeras and Lizapa Grande, 1000 m, 24 Jun 1947, *A. Molina R. 167* (MO). **NICARAGUA. Boaco:** Sierra El Espino, 500–600 m, 11 Nov 1982, *P. Moreno 18526* (MO). **Carazo:** La Boquita, 13 Jul 1982, *R. Kral 69373* (MO). **Chinandega:** Faldas del Volcán Casita, 23 Jul 1982, *M. Araquistain 2982* (MO). **Chontales:** 13.5 km W of Juigalpa, 100 m, 28 Aug 1983, *M. Nee 27612* (MO); 14 km SSW of Comalapa, 150 m, 28 Aug 1983, *M. Nee 27619* (MO). **Estelí:** vicinity of Guava, 20 km of Estelí, 900 m, 5 Nov 1968, *A. Molina R. 23121* (MO). **Granada:** Granada, 16 Feb 1903, *C. F. Baker 157.* **Jinotega:** "El Eden," 7 km a la entrada del camino viejo a Jinotega, 840–860 m, 25 Oct 1983, *S. Vega & W. Robleto 99* (MO, TEFH). **Leon:** Santa Rosa del Peñón, 500–600 m, 11 Sep 1980, *P. Moreno 2440* (MO). **Madriz:** Cerro Quisica, 800–1100 m, 23 Nov 1979, *W.D. Stevens 16181* (MO). **Managua:** El Tamrindo, ± 300 m, 1 Dec 1983, *P. Moreno 22524* (MO); entrada a la hacienda San Ramón, 18 Oct 1982, *P. Moreno* 17919 (MO). **Masaya:** Laguna de Apoyo, 100–140 m, 20 Sep 1981, *P. Moreno 11140* (MO). **Matagalpa:** El Caao–Caserio Puertas Viejas, 460 m, 25 Aug 1983, *J.S. Miller 1286* (MO). **Nueva Segovia:** 6 km N of Ocotal, 700 m, 15 Jun 1977, *D. Neill 2145* (MO).

1g. Diospyros acapulcensis Kunth subsp. **pedromorenoi** M.C. Provance, I. García & A.C. Sanders, subsp. nov. (**Figs. 12, 20c–d**). Type: NICARAGUA. Estelí: San Juan de Limay, Valle San Juan de Tranquera, entre San Juan de Limay y Pueblo Nuevo, 13°15'N, 86°35'W, 400–450 m, 5 Sep 1980, *P. Moreno 2386* (holotype: MO-3307430!).

Arbores et frutices a *Diospyros acapulcensi* ssp. *acapulcensi* similis sed differt petiolis longioribus rugulatis malvinus vel purpureus glauco-pruinosis, laminis foliorum supra dense vestitis trichomatibus crispulatis ferrugineus ac costis latioribus, et fructibus majoribus (usque ad 3.5 cm diam.).

Trees, rarely shrubs, 2–12 m tall; **trunk** unknown; **stems** glabrous to densely hairy when mature, the hairs wavy, ascending, dull orange to golden-brown, becoming desiccated and ashy, those of young stems sometimes mixed with sparse longer, wavy, spreading to ascending hairs, with clavate glandular hairs often present, but deciduous and leaving the brown to dark brown epidermis viscid. **Petioles** 4–7 mm long, densely tomentulose



Fɪɢ. 12. *Diospyros acapulcensis* Kunth subsp. *pedromorenoi* M.C. Provance, I. García & A.C. Sanders, subsp. nov. A. Fruiting branchlet with loose leaf and fruit from Los Cerritos, Dept. of Estelí, Nicaragua (*P. Moreno 10887*, MO). B. Fruiting branchlet, based on the holotype from Valle San Juan de Tranquera, Dept. of Estelí, Nicaragua (*P. Moreno 2386*, MO-3307430). C–G. Based on *P. Moreno 21526* (MO) from Hacienda San Antonio, Dept. of Boaco, Nicaragua. C. Male inflorescence. D. Male calyx. E. Adaxial surface of male calyx. F. Diagram of proximal region of male corolla tube. G. Stamen.

or with short golden-brown wavy hairs, but soon glabrous, rugose, glaucous-pruinose, mauve to dark purple, reddish-brown and shiny where rubbed, clavate glandular hairs sometimes present on the upper surface. **Lamina** chartaceous, 60–122 mm long, 25–60 mm wide, length to width ratio (1.8–)2–3(–3.3) **:** 1, broadly obovate, oblanceolate or elliptic, *base* short-attenuate, *margin* often slightly revolute, *apex* subacute to obtuse or rounded, sometimes slightly acuminate or tapering abruptly; **lower lamina surface** densely hairy, the hairs short and curly to wavy, golden to reddish-brown, clavate glandular hairs often present, deciduous, leaving the reddish-brown epidermis viscid, the stomatal apparatus translucent and inconspicuous; **upper lamina surface** glabrate to ascending wavy-hairy, deciduous, clavate glandular hairs often present, but deciduous, the epidermis viscid, dark greenish-brown, papillate or sometimes crystal-papillose,. **Venation** eucamptodromous, usually 3–5-ribbed; **midrib** prominent below, conspicuously wide, hairs denser on the midrib than on the lamina, lower midrib glaucous-pruinose, shiny, reddish-brown; **lateral veins** 6–9 per side, very prominent to subcylindrical below, slightly raised above; **3° veins** prominent below; **4–5° veins** often darkened below. **Male inflorescences** 3–5(–6)-flowered cymes, densely buff to dull orange with wavy hairs; **peduncles** 4–6 mm long; **pedicels** 1–3 mm long, bracts lanceolate, 1–1.6 mm long, conduplicate. **Male flowering calyx** densely clear to light gold minute wavy-hairy outside, with clavate glandular hairs often present, deciduous, epidermis reddish-brown, *tube* 2.0–3.5 mm long, ± 3 mm wide, glabrous inside, *lobes* lance-ovate to ovate, 3.0–5.5 mm long, 2–3 mm wide, barely winged or not, acute to acuminate, glabrous to sparsely hairy inside with a narrow tomentulose intramarginal band, sometimes with sparse clavate glandular hairs present; **male corolla tube** 3.2–5.5 mm long, ± 2.5 mm wide, white sericeous outside with 3 small basal shield-shaped glabrous areas; **male corolla lobes** oblong-ovate, 2.5–3 mm long, ± 1.8 mm wide. **Stamens** 12; **filaments** adnate to the corolla in two 6-stamen tiers, the inner basal, the outer just above, ± 1 mm long, dark reddish-brown. **Female inflorescence and flowers** unknown except **style remnants on immature fruit** fused into a hairy column, 3 in number. **Fruiting pedicels** stout, 2–4 mm long, densely hairy, with clavate glandular hairs sometimes present, epidermis reddish-brown, bracts (0–)2, opposite, often immediately subtending the fruit, broadly ovate, 1.8–1.9 mm long, flat. **Fruiting calyx** campanulate to infundibuliform, densely minutely kinky to curly-hairy outside, the hairs, orangish to reddish-brown, clavate glandular hairs sometimes present, but deciduous, leaving the reddish-brown epidermis viscid, *tube* 5–7(–8) mm long, glabrous inside basally, *lobes* obtuse to acute, 4.5–6 mm long, (9–)12–15 mm wide, abruptly acuminate to a blunt point, margins often reflexed, golden to reddish sericeous inside except for a wide tomentulose intramarginal band. **Fruit** up to 3.5 cm in diameter, glabrous to scantily hairy, glaucous-pruinose, dull yellow, mauve or purplish, often reddish-brown where rubbed, yellow to orange in life. **Seeds** 14–16 mm long, 6–7 mm radial depth, 5–6 mm wide.

This subspecies is notable for leaves with a broad, viscid, reddish-brown abaxial midrib, dense with curly to kinked reddish-brown hairs, rugose mauve to purple glaucous-pruinose petioles, and large fruit that are second in size only to *D.* aff. *inconstans* for the complex in Mesoamerica. It seems to be endemic to Nicaragua (Fig. 24), with most collections from gallery forests and rocky slopes of west-central Nicaragua. It forms intermediates with *D. a.* subsp. *nicaraguensis* in several areas. The fruit is known locally as 'chocollo,' 'chochoyo' or 'chocoyito' and is eaten when mature. This subspecies is named in honor of Pedro P. Moreno, the collector of the type, and an expert on the flora of Nicaragua.

Specimens examined. **NICARAGUA. Boaco:** Hacienda San Antonio, 200 m, 14 Jun 1983, *P. Moreno 21526* (MO); 1 km N of San José de Los Remates, 650 m, 27 Jul 1983, *W.D. Stevens & P. Moreno 22297* (MO); **Chontales:** ca. 13.1 km N of Hwy 7 on road to Cuapa, ca. 155 m, 15 Feb 1978, *Pipoly 2029* (MSC); same location and date, *W.D. Stevens 6493* (MO); Hacienda Veracruz, 120–475 m, 17 Jul 1983, *Stevens 22256* (MO), same location, 4–6 Aug 1983, *W.D. Stevens 22368* (MO); 8 km S of Cuapa, 200–375 m, 21 Sep 1983, *M. Nee 28260* (MO). **Estelí:** Salto de Estanzuela, 1000 m, 10 Sep 1980, *M. Guzmán et al. 1162* (MO); Llano Gualilica, 280 m, 2 Sep 1980, *P. Moreno 2091* (MO); Paso León, 800–820 m, 29 Mar 1983, *P. Moreno 21063A* (MO); Los Cerritos, 860–900 m, 13 Sep 1981, *P. Moreno 10887* (MO); Portal de Belén, 660–800 m, 1 Aug 1983, *P. Moreno 21845* (MO); Cerro Cucamonga, Río Waswalí, 800–850 m, 3 Jan 1982, *P. Moreno 14119* (MO); Res. Nat. Miraflor, 600–850 m, 23 Dec 1999, *R. Rueda et al. 12568* (MO); 0.5 km S de San Juan de Limay, 250–300 m, 3 Sep 1980, *P. Moreno 2236* (MO); Llano el Pozo, 1200–1300 m, 26 Dec 1982, *P. Moreno 19345* (MO); 'Hacienda La Grecia,' 518 m, 2 Sep 1980, *P. Moreno 2173* (MO) & *2134* (MO); Las Cuevas, 1000–1100 m, 1 Feb 1983, *P. Moreno 19918* (MO); along road to Yalí, 820–1100 m, 14 Nov 1979, *W. Stevens & A. Grijalva 15508* (MO). **Leon:** Hacienda Las Lajas, 300–350 m, 4 Sep 1980, *P. Moreno* 2295 (MO); Malpaísillo, faldas del Cerro Negro, 100–200 m, 8 May 1984, *M. Castro 122* (MO); La Chibola, 28 Jun 1984, *M. Castro 143* (MO); Llano San Lorenzo, 250–300 m, 4 Sep 1980, *P. Moreno 2327* (MO). **Managua:** camino entre "Puertas Viejas" y "Santa Juana," ± 100–120 m, 1 Jul 1983, *M. Araquistain 3584* (MO). **Matagalpa:** 3 km al E de Puertas Viejas, 400–500 m, 10 Feb 1983, *P. Moreno 20105 & 20090* (MO); camino de "Puertas Viejas," 500–600 m, 21 Sep 1983, *M. Araquistain 3668* (MO, BH); ca 5 km al NW de la ciudad de Matagalpa, 22 Jul 1983, *A. Grijalva & F. Ortiz 2825* (MO).

1h. Diospyros acapulcensis Kunth subsp. **rivensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov. (**Figs. 13, 14, 15, 17a–i, 21d, 22a–b**). Type: NICARAGUA. Rivas: Isle Ometepe, Volcán Concepción, camino de "Los Hatillos" a "Altagracia," 11°34'N, 85°35–39°W, 133–150 m, 13 Aug 1984, *W. Robleto 1088* (holotype: MO-3508354!; isotype: TEFH!).

Arbores et frutices a *Diospyros acapulcensi* ssp. *acapulcensi* similis sed differt laminis foliorum plerumque longioribus ellipticioribus infra strigosis trichomatibus rectis adpressibus vel subadpressibus apicem versus, supra saepe onustis fasciculis parvis crystallis albis opacis secus venas impariter projectis, et calycibus fructiferis lobis angustioribus.

Trees or shrubs 2–10 m tall; **trunk** unknown; **stems** moderately to densely velutinous when young, the hairs tawny to reddish-brown, slightly wavy or curved, subappressed, sometimes also minutely hirtellous, glabrous or only sparingly hairy when mature, the remnant hairs shorter, curved, and more upright, clavate glandular hairs often present, the epidermis sometimes very dark. **Petioles** sometimes winged, much broader than thick, 4–8 mm long, epidermis relatively smooth, yellowish to brownish, shiny and viscid, lower surface glabrate to velutinous, the hairs appressed to subappressed, straight to slightly wavy, upper surface somewhat flattened to slightly canaliculate, puberulent, the hairs appressed to upright. **Lamina** chartaceous to subcoriaceous when mature, 70–130(–150) mm long, 25–50 mm wide, length to width ratio (2.1–)2.5–3.5(–3.8) **:** 1, widely obovate to narrowly oblanceolate or elliptic, often crystal-papillose, *base* cuneate to acutely short-attenuate, decurrent on the petiole, *margin* slightly thickened to revolute, sometimes darkened, *apex* slightly acuminate to rounded; **lower lamina surface** velutinous to subsericeous, the hairs usually straight, but also curved, appressed and subappressed, cream to tan, clavate glandular hairs often present, the epidermis chartreuse to olive or brownish-green, sometimes papillose, the stomatal apparatus obscure; **upper lamina surface** often tented, sparsely to moderately hairy, the hairs straight or curved, appressed to ascending, sometimes deciduous, especially near the midrib, sometimes leaving a seeping ring-like gland, epidermis light greenish-brown to brownish-green, shiny. **Venation** arcolanguid, sometimes 3-ribbed; **midrib** prominent below, subsericeous, the hairs curved to nearly straight, subappressed to upright, thickish, tawny to golden-brown, clavate glandular hairs often present, but deciduous and leaving the yellowish to reddish-brown epidermis viscidulous, midrib slightly impressed to raised above, impressed along the lamina-midrib seam, pubescent, the hairs wavy to curved, ± upright; **lateral veins** (5–)6–9(–12) per side, prominent below, raised above; **3° veins** slightly raised to prominent below, barely raised above. **Male inflorescences** 3–5(–6)-flowered cymes, densely pubescent, the hairs kinky, curved, or wavy, cream, epidermis brown; **peduncles** 4–6 mm long; **pedicels** 2–3 mm long, bracts ovate to oblong-ovate, or deltoid. **Male flowering calyx** moderately to densely hairy outside, the hairs variously straight, wavy, or curly, cream to tawny, the epidermis orangish-brown to reddish, sometimes quite dark, *tube* 2.5–4 mm long, 3–3.2 mm wide, glabrous inside, *lobes* acute, 1.8–4 mm long, 1.5–3 mm wide, glabrous inside, except for a narrow tomentulose intramarginal band, and some scattered appressed wavy hairs on the median; **male corolla tube** 4–5 mm long, 2–4 mm wide, cream, tawny, yellowish or reddish-pink sericeous outside except for 3 basal shield-shaped glabrous zones; **male corolla lobes** reportedly cream to silvery and pearlescent in life, lanceolate to ovate or oblong, ± 3.5 mm long, 1–2 mm wide. **Stamens** 12–14; **filaments** partly adnate to corolla base, partly inserted on the receptacle, 1.2–1.5 mm long, rarely geminate, dark reddish-brown; **anthers** lanceolate to ovate or oblong-ovate, 1.1–2 mm long, yellowish, nearly cylindrical prior to opening, apex long-acuminate to blunt. **Female inflorescences and flowers** unknown. **Fruiting pedicels** 0.5–9 mm long, minutely hairy, often coated with exudate, bracts lanceolate to ovate, 1–2 mm long, navicular. **Fruiting calyx** spreading to crateriform (in the widespread form) or campanulate to vaguely infundibuliform (in the pale-leaved form), usually splitting below the sinuses, minutely sericeous to tomentulose outside, clavate glandular hairs sometimes present, the epidermis viscid, sometimes dark brown, sometimes black gland-dotted, *tube* 4–7.5 mm long, upper 1/2–3/4 sericeous inside, the lower 1/2–1/4 glabrate, sometimes

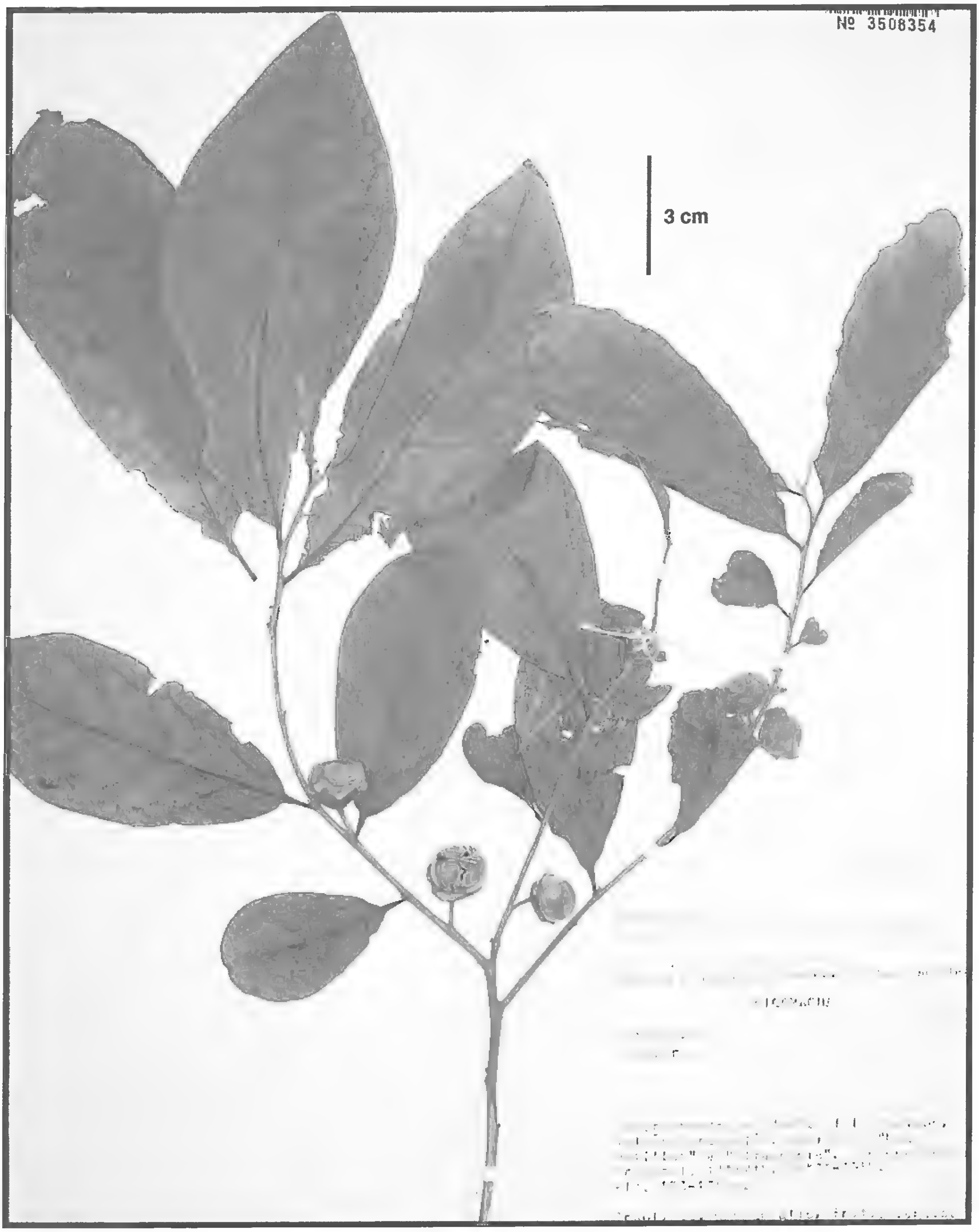


Fig. 13. Holotype of *D. acapulcensis* Kunth subsp. *rivensis* M.C. Provance, I. García & A.C. Sanders, subsp. nov. from Volcán Concepción, Isle Ometepe, Dept. of Rivas, Nicaragua (*W. Robleto 1088,* MO-3508354).

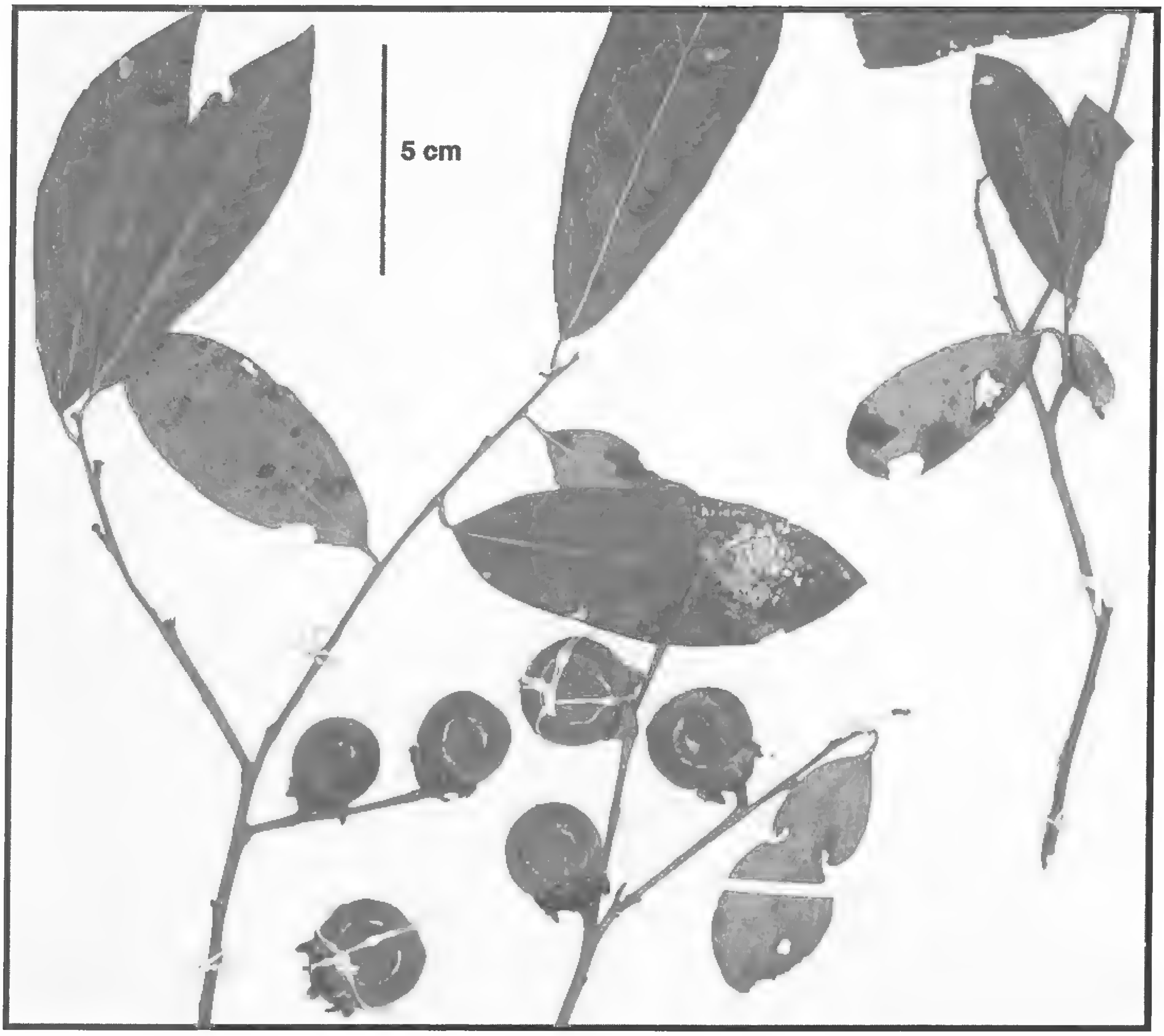


Fig. 14. Pale-leaved form of *D. acapulcensis* Kunth subsp. *rivensis* M.C. Provance, I. García & A.C. Sanders, subsp. nov. from Laguna de Apoyo, Dept. of Masaya, Nicaragua (*P. Moreno & J.C. Sandino 6185*, MO-3307419).

with scattered, thick, cylindrical glands, *lobes* obtuse, (2.5–)3.5–7 mm long, 9–15 mm wide, spreading to strongly reflexed, the apex often folded to an acute point, cream to tan sericeous inside except for a tomentulose intramarginal band. **Fruit** 2–2.6(–3) cm in diameter, glabrate, sometimes minutely hairy, tawny hairs present at the apex, epidermis sometimes minutely red to black gland-dotted, usually glaucous-pruinose, sometimes scintillant, dull yellow to brownish-orange or mauve, reportedly yellow or orange when mature, and orange to red when ripe. **Seeds** 12–13 mm long, 5.5–7 mm radial depth, 4–5 mm wide.

This subspecies is found near and along the west coast of Nicaragua and northwest coast of Costa Rica, as well as on the islands of Zapatera and Ometepe in Lake Nicaragua, Nicaragua (Fig. 24). It is mainly found between sea level and 150 m in tropical deciduous forest near shorelines and along riverbanks, and sometimes in marshy areas. There are also some mid-elevation occurrences around 700 m associated with volcanic slopes. Specimens from the area between Lake Managua and Lake Nicaragua represent a form with pale abaxial leaf surfaces (Figs. 14, 15, 17a–e, 21d) found in dry tropical forest and secondary matorral between 100 and 350 m elevation. These pale-leaved plants also vary subtly in some characteristics of stem and leaf vestiture from collections of the subspecies made elsewhere, and seem to have a different fruiting

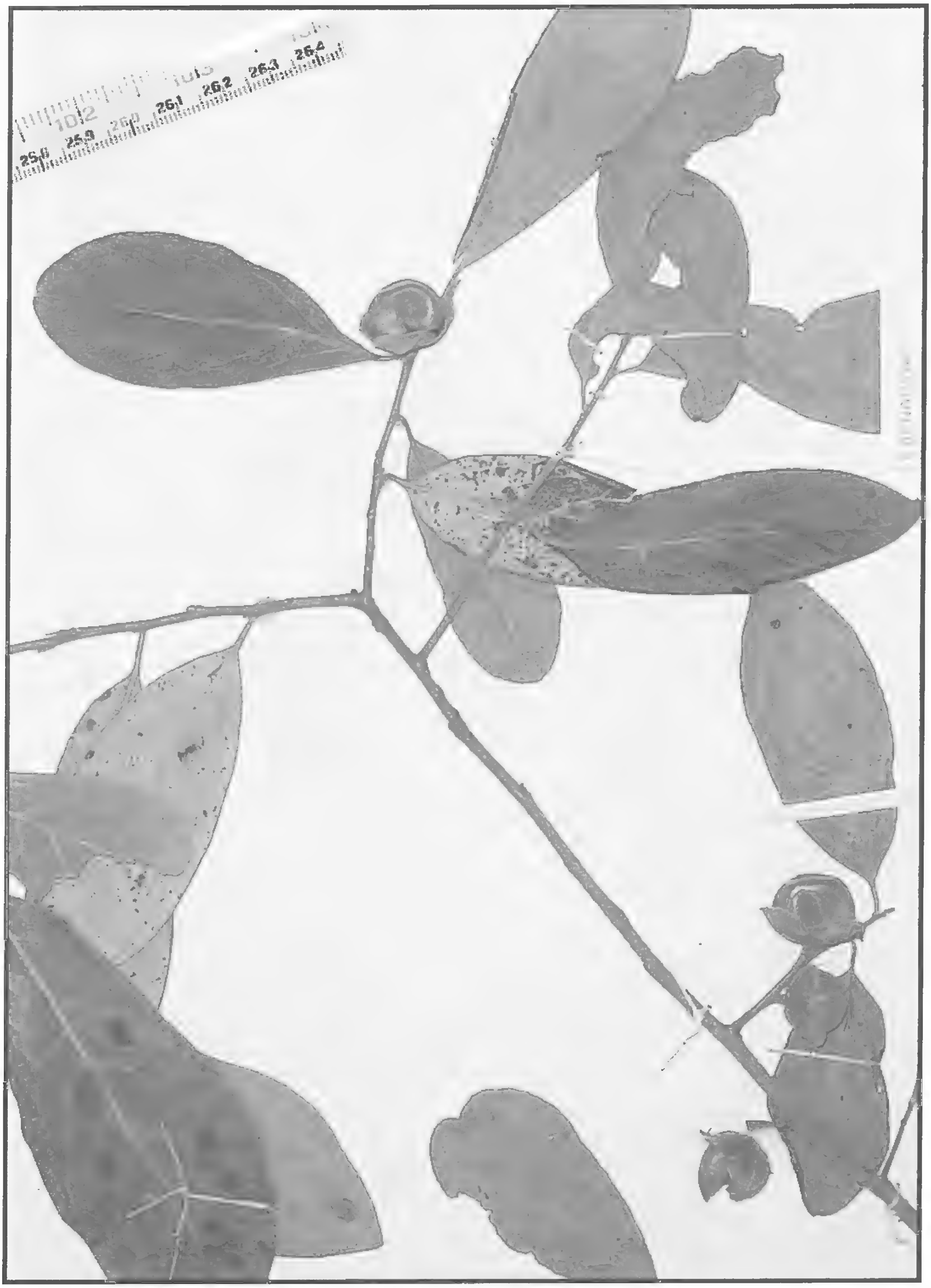


Fig. 15. Pale-leaved form of *D. acapulcensis* subsp. *rivensis* from Costado S de Lomas de Villa Fontana, Dept. of Managua, Nicaragua (*A. Grijalva 775*, MO).

calyx shape. However, the forms are indistinguishable following quantitative comparison of their vegetative and fruiting inflorescence characters. Currently, we consider plants from the area between Lake Managua and Lake Nicaragua to represent an interesting ecological variant.

Specimens that represent intergrades with *D. a.* subsp. *nicaraguensis* occur on the Island of Momotombito in Lake Managua, with *D. a.* subsp. *veraecrucis* on the volcanic Isla de la Tigre off the southern coast of Honduras, and with *D. a.* subsp. *guanacastensis* in Costa Rica. A combination of characters distinguishes this subspecies from others, including a tented lamina, straight to slightly curved, appressed to subappressed hairs on the abaxial lamina and midrib surfaces, and clusters of opaque white excrescences on the lower lamina surface. This subspecies sometimes resembles *D. a.* subsp. *veraecrucis*, but the lamina of *D. a.* subsp. *rivensis* is more elliptic, and the leaf apex more rounded. In *D. a.* subsp. *rivensis*, hairs on the lower lamina and midrib surfaces are not as straight and strongly appressed as in *D. a.* subsp. *veraecrucis*. Also petioles of this taxon tend to be longer and thinner, and the fruiting calyx lobes narrower than in *D. a.* subsp. *veraecrucis*.

Diospyros a. subsp. *rivensis* tends to have an elliptic leaf. This accounts for significant differences in several lamina shape parameters between this taxon and *D. a.* subsp. *nicaraguensis* and *D. a.* subsp. *guanacastensis*. Lamina width is also significantly narrower in *D. a.* subsp. *rivensis* than in *D. a.* subsp. *nicaraguensis*. Venation is significantly different between *D. a.* subsp. *rivensis* and *D. a.* subsp. *guanacastensis*.

This taxon has been collected in a number of protected areas, such as Santa Rosa National Park on the Santa Elena Peninsula in northwestern Costa Rica, and in Nicaragua at Reserva Natural Lagunetas de Mecatepe, Parque Nacional Volcán Masaya, Zapatera Archipelago National Park, and in Cosigüina Volcano Natural Reserve. The fruit is described as pale orange to red and sweet in late February to May. The local name 'chocoyito' appears on collections of the pale-leaved form from the area between Lake Managua and Lake Nicaragua, and on collections from the Department of Chinandega, and the islands of Zapatera and Ometepe on Lake Nicaragua. The subspecific epithet refers to the Department of Rivas, where the holotype was collected.

Specimens examined (except pale-leaved form). **COSTA RICA. Guanacaste:** P.N. Santa Rosa, Península de Santa Elena, 50–150 m, 18 Aug 1994, *B. Hammel & C. Cano 19581* (K); P.N. Santa Rosa, Península de Santa Elena, 50 m, 15 May 1993, *Carolina Cano 85* (MO); P.N. Santa Rosa, Península de Santa Elena, 3 Dec 1993, *R. Espinoza 991* (MO); P.N. Santa Rosa, Península de Santa Elena, 30 m, 30 Jul 1996, *J.F. Morales & A. Soto 5567* (MO). **Puntarenas:** Cantón de Garabito, Punta Agujas, 0–5 m, 19 Sep 1996, *J.F. Morales 5832* (K). **NICARAGUA. Chinandega:** Res. Nat. Cosigüina, Los Placeres, 0–600 m [± 37 m], 27 Mar 2001, *R. Rueda et al. 15977* (MO). **Granada:** faldas del Volcán Mombacho, bordeando la Laguna de Juan Tallo, 65 m, 23 Jul 1980, *M. Guzmán et al. 549* (MO); Isla Zapatera, Ensenada y Finca Sonzapote, 40–60 m, 20 Jan 1982, *J.C. Sandino 1910* (MO); Isla Zapatera, sobre el camino a Sonzapote, 40–55 m, 20 Jan 1982, *J.C. Sandino 1877* (MO); Isla Zapatera, entre Finca Sonzapote y Ladera NE de El Cerro, 100–300 m, *J.C. Sandino 2056* (MO); Isla Zapatera, Cerro El Llano, ca. 100 m, 13 Aug 1982, *A. Grijalva 804* (MO); Isla de Zapatera, punta al N de Finca La Habana, 30–40 m, 24 Jan 1982, *J.C. Sandino 2105* (MO); Isla Zapatera, costada NE de Hacienda Santa Maria, ± 100 m, 22 Nov 1982, *A. Grijalva 1892* (MO, TEFH). **Managua:** El Paraguay, km 26, carr. a San Rafael del Sur, 700 m, 9 Jun 1983, *P. Moreno 21466* (MO); Finca Armenia, 600 m, 2 Oct 1982, *A. & M.V. Grijalva 1330* (MO); Volcán de Chiltepe, 100–200 m, 2 Jun 1981, *P. Moreno & J. Henrich 8947* (MO); S slope and rim of Apoyeque, 220–350 m, 18 Nov 1980, *W.D. Stevens & P. Moreno 18448* (MO); "La Amistad," a 7 km de La Concha, carr. a San Rafael del Sur, 550–600 m, 11 Dec 1980, *P. Moreno 5261* (MO). **Masaya:** P.N. Volcán Masaya, lava flow N of Volcán Masaya, 250 m, 29 Nov 1977, *D. Neill 3036* (MO); P.N. Volcán Masaya, NW side of El Comalito, 285 m, 8 Feb 1978, *J.J. Pipoly 1732* (MSC); same location and date, *W.D. Stevens 6256* (MO). **Rivas:** "El Pegón," al SE de Rivas, 50 m, 21 Jan 1981, *P. Moreno 6109* (MO); convergence of Río La Pita and Río Escalante, 20 m, 3 Aug 1978, *W.D. Stevens 9692* (MO); Isla Ometepe, Volcán Maderas, ± 45 m, 16 Jun 1984, *W. Robleto 895* (MO); Isla Ometepe, Volcán Maderas, sitio "Las Cuchillas," 400 m, 14 Jun 1984, *W. Robleto 829* (MO); Isla de Ometepe, playa de Finca Santa Cruz y el Istmo de Istián, 17 Jul 1981, *J.C. Sandino 965* (MO); Isla de Ometepe, N shore of isthmus, near Santa Cruz, 25 Feb 1978, *J.J. Pipoly 2110* (MSC); same date and location, *W.D. Stevens 6623* (MO); Isla Ometepe, Volcán Concepción, 50–80 m, 28 Oct 1984, *W. Robleto 1444* (MO, TEFH); Isla Ometepe, 40–55 m, 14 Sep 1983, *P. Moreno 22040* (MO).

Specimens of pale-leaved form of *D. acapulcensis* subsp. *rivensis* examined: **NICARAGUA. Granada:** Laguna de Apoyo, 110–180 m, *P. Moreno 11174* (MO). **Managua:** Costado S de Lomas de Villa Fontana, ± 250 m, 6 Aug 1982, *A. Grijalva 775* (MO, TEFH); Las Sierritas, W de Lomas Santiago, 160 m, 10 Jun 1982, *J.C. Sandino 3048* (MO). **Masaya:** Camino entre restaurante Tenampa y Piedra Quemada, 7 Apr 1982, *J.C. Sandino 2540* (MO); P.N. Volcán Masaya, W shore of Laguna de Masaya, 135–145 m, 31 Mar 1980, *W.D. Stevens et al. 16871* (MO), ± 11°59'N, 87°07'W, 135–145 m, 31 Mar 1980, *W.D. Stevens, M. Guzmán & D. Castro 16871* (MO); Laguna de Masaya al NW de la ciudad, 11°58'N, 86°07'W, 100–150 m, 24 Oct 1980, *P. Moreno 4019* (MO); lado NW de la Laguna de Masaya, 12°00'N, 86°08'W, 140 m, 23 Feb 1981, *P. Moreno & A. Lopez 7171* (MO); N de Volcán Santiago, Piedra Quemada, 12°01'N, 86°09'W, [200 m], 5 Aug 1981, *J.C. Sandino 1165* (MO); "Piedra Quemada" lava flow, 1 km NW of Volcán Santiago, [12°01'N, 86°10'W], 350 m, 28 Oct 1976, *D. Neill 1111* (MO); a orillas de la Laguna Masaya, 11°58'N, 86°08'W, 160 m, 21 Jan 1981, *P. Moreno 6140* (MO); Laguna de Apoyo costado Este [probably West, since the department, geographic coordinates, and elevation imply the crater near the west coast], 11°56'N, 86°04'W, ca. 100, 24 Oct 1980, *P. Moreno 3948* (MO).

1i. Diospyros acapulcensis Kunth subsp. **veraecrucis** (Standl.) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov. (**Figs. 16, 18f–k, 19d**). Basionym: *Maba verae-crucis* Standl. Contr. U.S. Natl. Herb. 18:119. 1916. *Diospyros verae-crucis* (Standl.) Standl. Publ. Carnegie Inst. Wash. 461: 80. 1935. Type: MEXICO. Veracruz: Catemaco, 300 m, 26 Apr 1894, *E.W. Nelson 429* (holotype: US-569278; isotype: US-569277).

Maba purpusii Brandegee, Univ. Calif. Publ. Bot. 7(10): 329. 1920. MEXICO. Veracruz: Barranca de Panoaya, [ca. 19°10'N, 96°24'W], Sep 1919, *C.A. Purpus 8516* (holotype: UC-204975, internet image!; isotype: MO, internet image!).

Trees and shrubs 2–25 m tall; **trunk** up to 40 cm in diameter; **stems** glabrous or with some persisting hairs, the young stems puberulent, the hairs sometimes curved, longer wavy subappressed hairs often present towards the shoot apex. **Petioles** minutely winged, (2–)3–6(–6.5) mm long, yellowish-green, glabrate below, puberulent above. **Lamina** membranaceous in spring, becoming chartaceous, (47–)60–105(–120) mm long (shade leaves to 160 mm long), (15–)20–40(–55) mm wide, length to width ratio (2–)2.5–3.5(–4.4) **:** 1, oblanceolate, obrhombic or obovate, sometimes nearly elliptic, *base* acute and short attenuate to cuneate, decurrent on the petiole, *margin* flat, *apex* acutely rounded to acuminate and bluntly pointed, usually mucronulate; **lower lamina surface** sparsely to moderately hairy, the hairs straight, appressed, distally oriented, white to gold, clavate glandular hairs often present, epidermis light olive to brownish-green, sometimes minutely papillose or crystal-papillose, the stomatal apparatus translucent and inconspicuous; **upper lamina surface** sparsely hairy, clavate glandular hairs often present, epidermis darker than the lower lamina surface, papillate or sometimes crystal-papillose. **Venation** arcolanguid to eucamptodromous, yellowish-green to orangish; **midrib** prominent below, hairs straight and appressed, glabrate to hirsutulous or ascending to upright puberulent; **lateral veins** 6–10(–12) per side, finely apparent to prominent below, inconspicuous to finely raised above; **3 veins** usually obscure, sometimes darkened. **Male inflorescences** 1–3-flowered cymes, densely pubescent with minute off-white hairs; **peduncles** 1–3 mm long; **pedicels** 0.5–1 mm long, bracts lanceolate, 1.0–2.5 mm long. **Male flowering calyx** densely hairy outside, the hairs slightly wavy, ascending to subappressed, clavate glandular hairs often present, giving the golden to dark brown epidermis a viscid appearance, *tube* 2–3 mm long, glabrous inside except immediately below the sinuses, *lobes* lance-ovate to ovate, (1–)1.5–3.0(–3.5) mm long, 2–2.5 mm wide; **male corolla tube** 5–7 mm long, 3 mm wide, mostly sericeous outside, the basal 1–2 mm glabrous, or with 3 basal shield-shaped glabrous zones, each 1–2 mm long; **male corolla lobes** lanceolate to ovate, 2–3.8 mm long. **Stamens** 12; **filaments** mostly adnate to the corolla, 0.8–1.5 mm long; **anthers** lanceolate, 2.5–3.0 mm long, often acuminate. **Female inflorescences** solitary, rarely a long-peduncled 3-flowered cyme with aborted lateral flowers. **Female flowering calyx** densely and minutely subappressed curly to wavy-hairy, clavate glandular hairs often present, *tube* subcylindrical, 3–5 mm long, *lobes* broadly rounded, (2.5–)3–5(–6.5) mm long, 4–7(–7.5) mm wide, often with a blunt point; **female corolla tube** cylindrical, thickish, 6–7 mm long, 3–4 mm wide, the upper 2/3–3/4 sericeous outside, lower 1/3–1/4 glabrous, border between the regions ± undulate; **female corolla lobes** ovate to oblong-ovate, sometimes, 3.5–4 mm long, 2 mm wide, the margins somewhat involute; **ovary** flask-shaped to obturbinate and vaguely 3-lobed, 2.5–3 mm long, 2.5–3 mm wide, hairy; **styles** narrow, 2–2.5 mm long, ± fused, spreading distally; **stigmas** bifid; **staminodes** (1–)4–6, resembling fertile stamens, or pale, broad, and inserted on the receptacle. **Fruiting pedicels** stout, (0.5–)1–4.5(–9) mm long, glabrous to moderately hairy. **Fruiting calyx** sparsely hairy outside, the hairs slightly wavy to straight, becoming pale and desiccated, epidermis shiny and viscid, often nearly black, *tube* cupulate, (5–)6–9 mm long, often tearing at the sinuses, usually bulbous at the base, densely hairy inside nearly to the base, the hairs short and thickish to longer and fine, epidermis often with dark blotches, *lobes* obtuse to rounded, (2.5–)3–7(–7.5) mm long, (8–)10–14(–15) mm wide, often abruptly acuminate to a blunt point, reflexed, sometimes just near

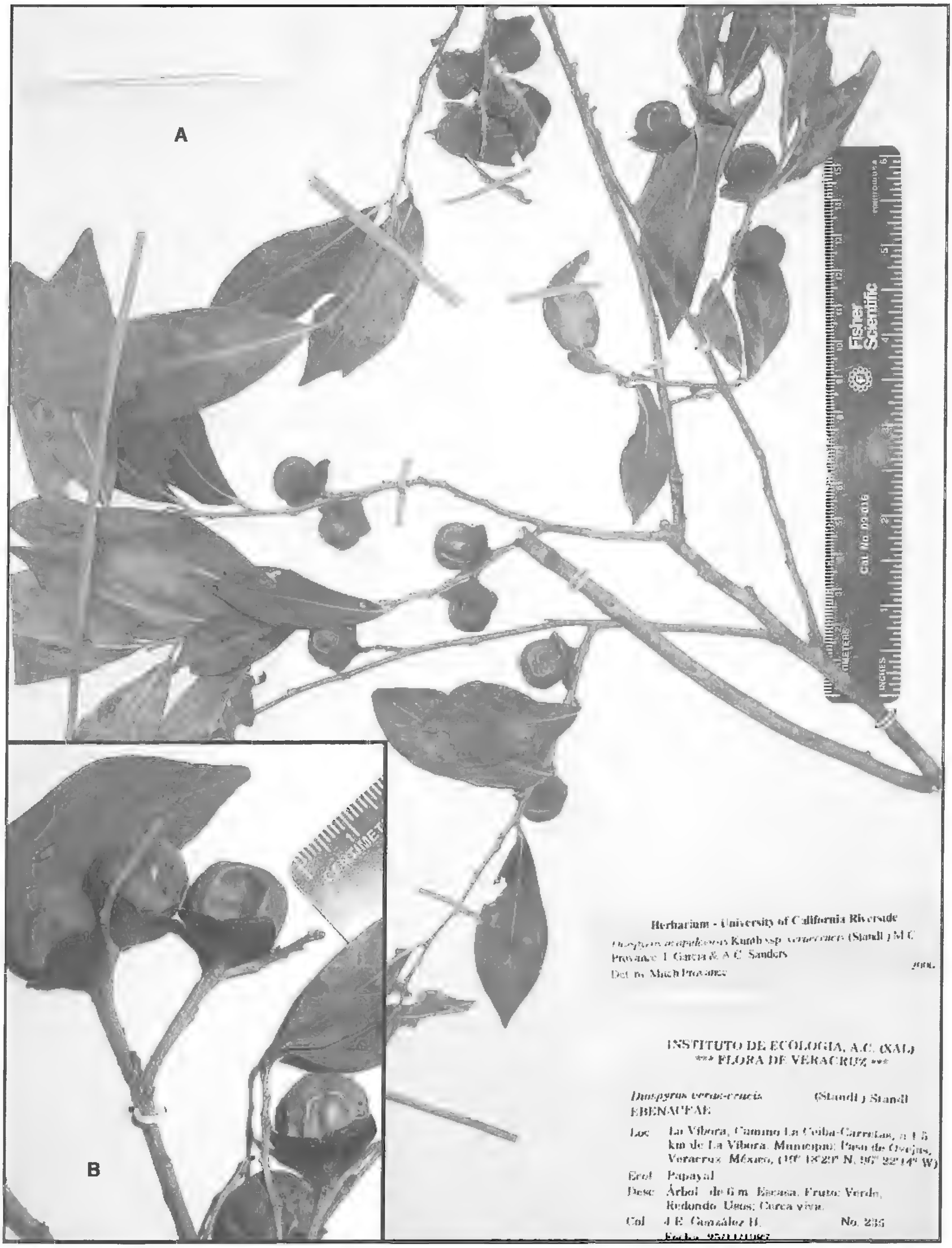

A
B
Fisher Scientific
Herbarium - University of California Riverside
Provance I. Garcia & A. C. Sanders
INSTITUTO DE ECOLOGIA, A.C. (XAL)
*** FLORA DE VERACRUZ ***
EBENACEAE
Papayal
No. 235

Fig. 16. *Diospyros acapulcensis* subsp. *veraecrucis*. A. Fruiting branchlet from La Víbora, Veracruz (*J.E. González H. 235*, IEB). B. Detail of fruiting branchlet from Cerro de la Mesa, Veracruz (*R. Acosta P. & N. Acosta B. 199*, IEB).

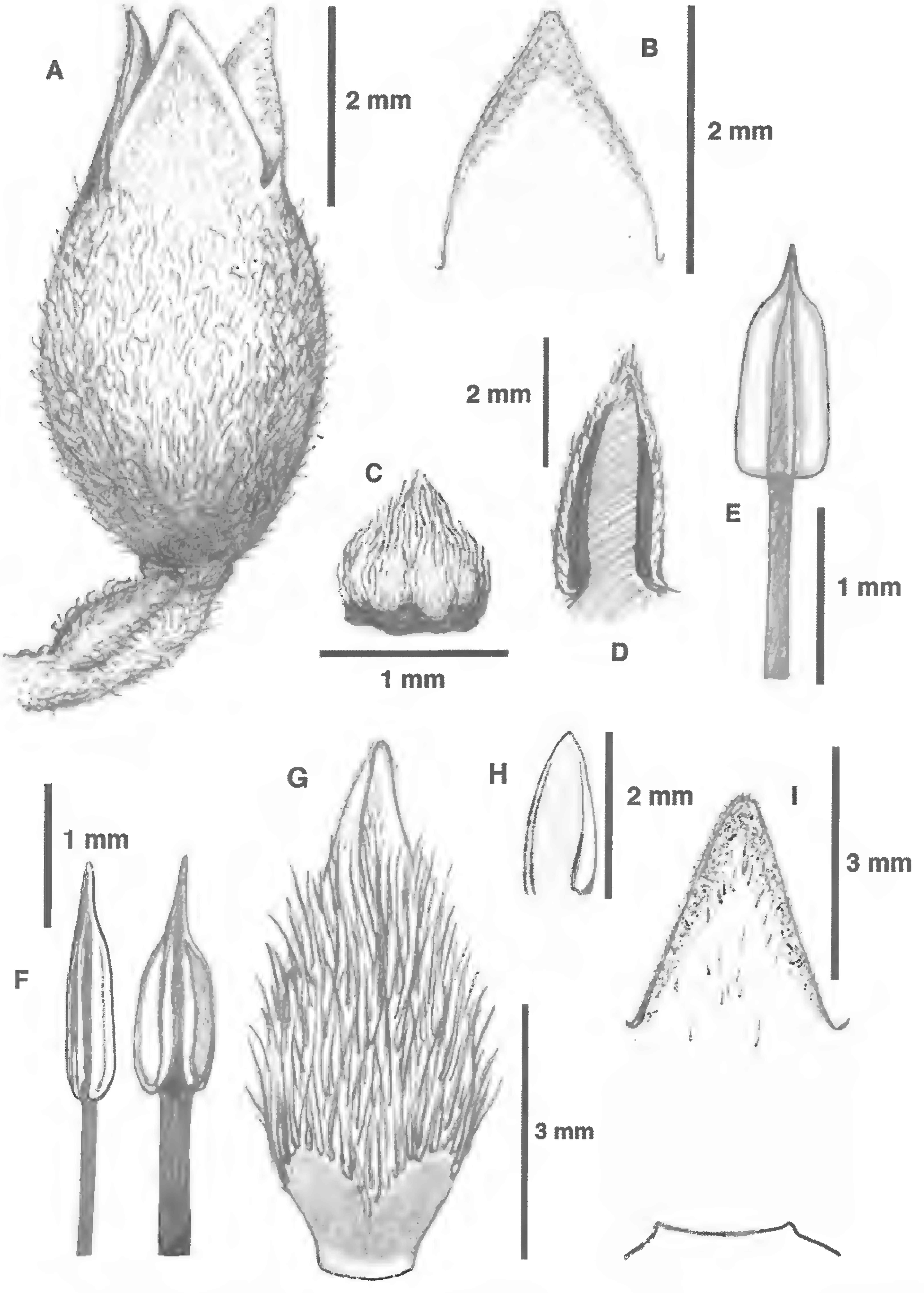


FIG. 17. Flowers of *Diospyros acapulcensis*. A–E. subsp. *rivensis* (pale-leaved form), based on *J.C. Sandino 3048* (MO) from Las Sierritas, Dept. Managua, Nicaragua. A. Immature male flower. B. Adaxial surface of male calyx. C. Pistillode. D. Male corolla lobe (adaxial view). E. Stamen. F–I. subsp. *rivensis,* based on *J.F. Morales 5832* (K) from Punta Agujas, Puntarenas, Costa Rica. F. Stamens (lateral view [left], adaxial view [right]). G. Male corolla. H. Male corolla lobe (adaxial view). I. Adaxial surface of male calyx.

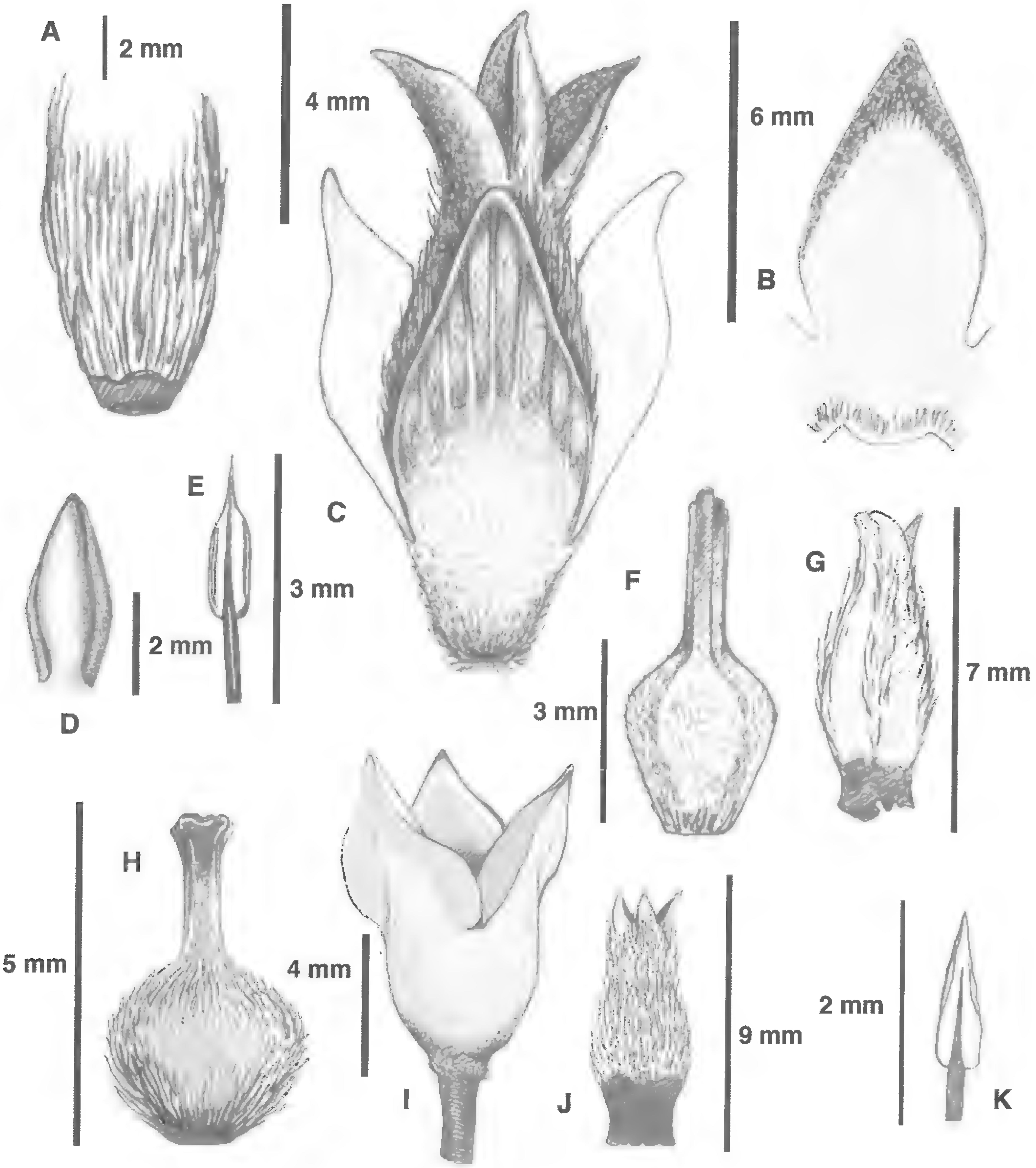


Fig. 18. *Diospyros acapulcensis* Kunth. A–E. subsp. *nicaraguensis*, based on *J.C. Sandino 4443* (MO) from S de Volcán Momotombo, Dept. of Leon, Nicaragua. A. Adaxial surface of male calyx. B. Male corolla tube. C. Male flower. D. Male corolla lobe (adaxial view). E. Stamen. F–G. subsp. *veraecrucis*, based on *E. Matuda 5228* (F) from Fraylesca, Chiapas, Mexico. F. Pistil. G. Female corolla. H–K. subsp. *veraecrucis*, based on *B.F. Hansen & M. Nee 7482* from Emiliano Zapata, Veracruz, Mexico. H. Pistil. I. Female flowering calyx. J. Female corolla. K. Staminode.

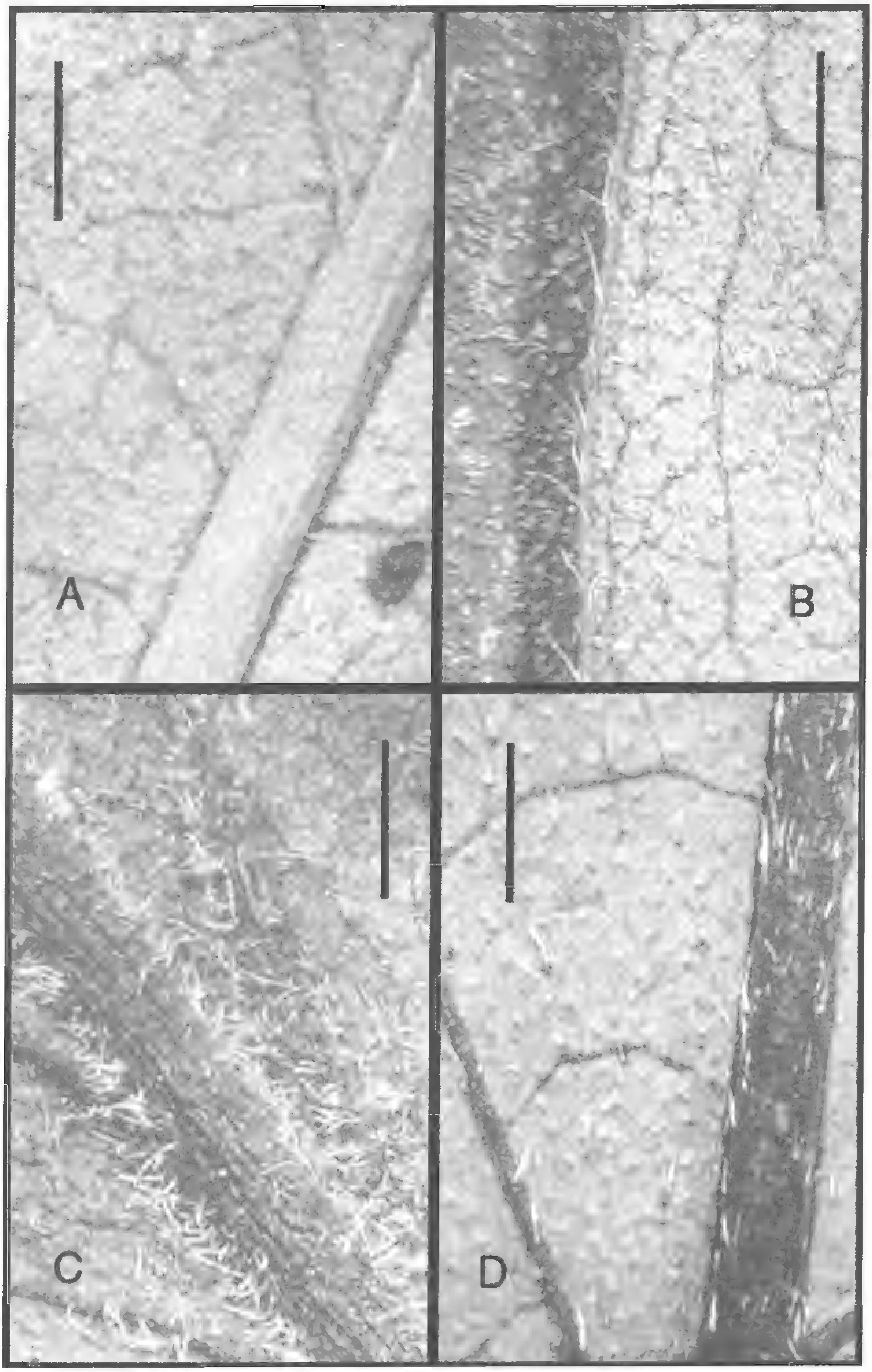


Fig. 19. Abaxial leaf surfaces of *D. acapulcensis* (scale = 1 mm). **A.** subsp. *chiquimulensis,* including midrib and extrafloral nectary (*A. Molina R. & A.R. Molina 12473,* F). **B.** subsp. *chiquimulensis*, margin detail (*A. Molina R. & A.R. Molina 12473,* F). **C.** subsp. *acapulcensis,* including midrib (*J.I. Calzada 9223,* XAL). **D.** subsp. *veraecrucis,* including midrib (*R. Acosta P. 741,* IEB).

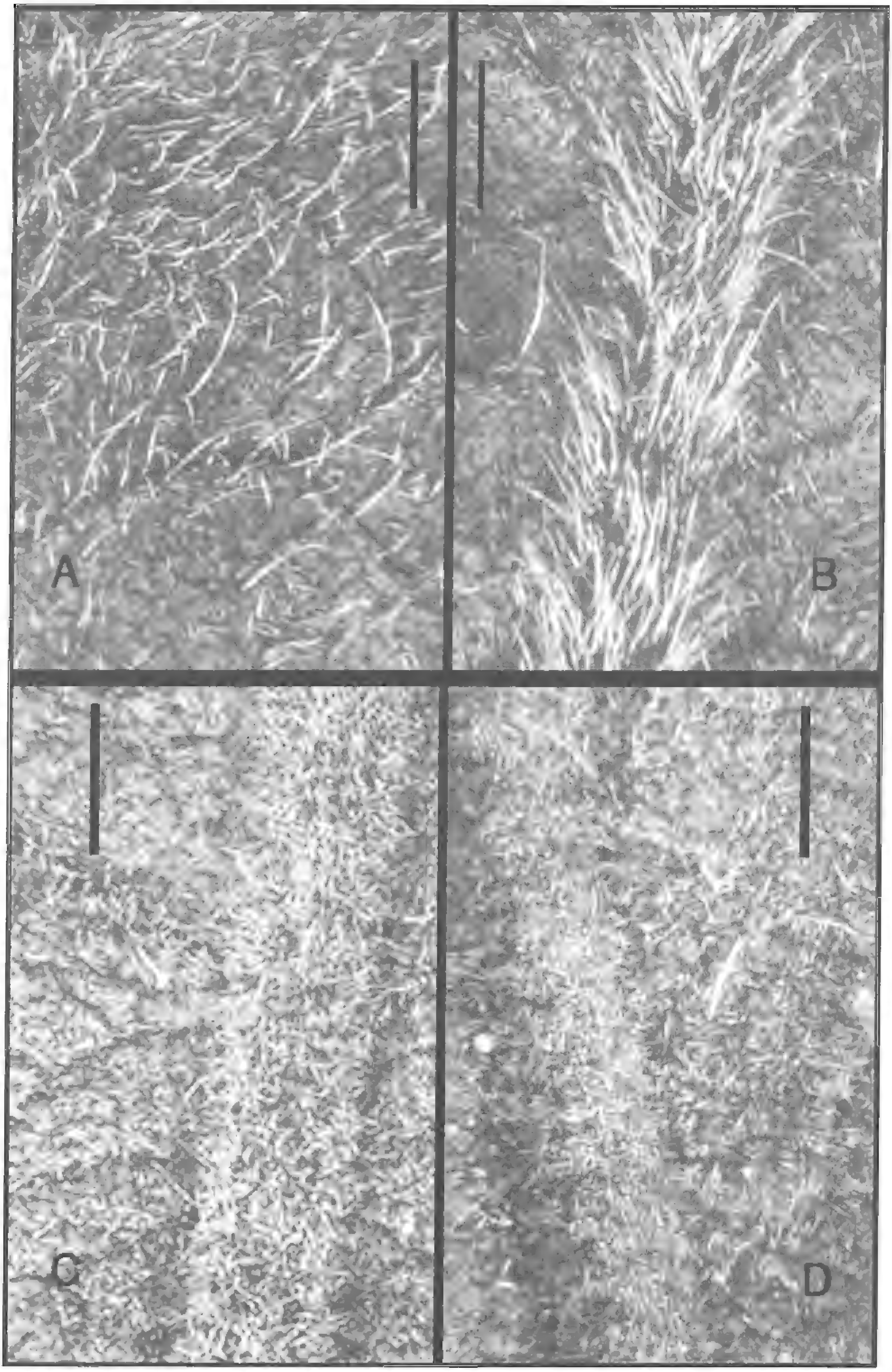


Fig. 20. Abaxial leaf surfaces of *D. acapulcensis* (scale = 1 mm). A. subsp. *guanacastensis* (from the holotype). B. subsp. *guanacastensis,* including midrib (from the holotype). C. subsp. *pedromorenoi,* including midrib (*P. Moreno 10887,* MO). D. subsp. *pedromorenoi,* including midrib (from the holotype).

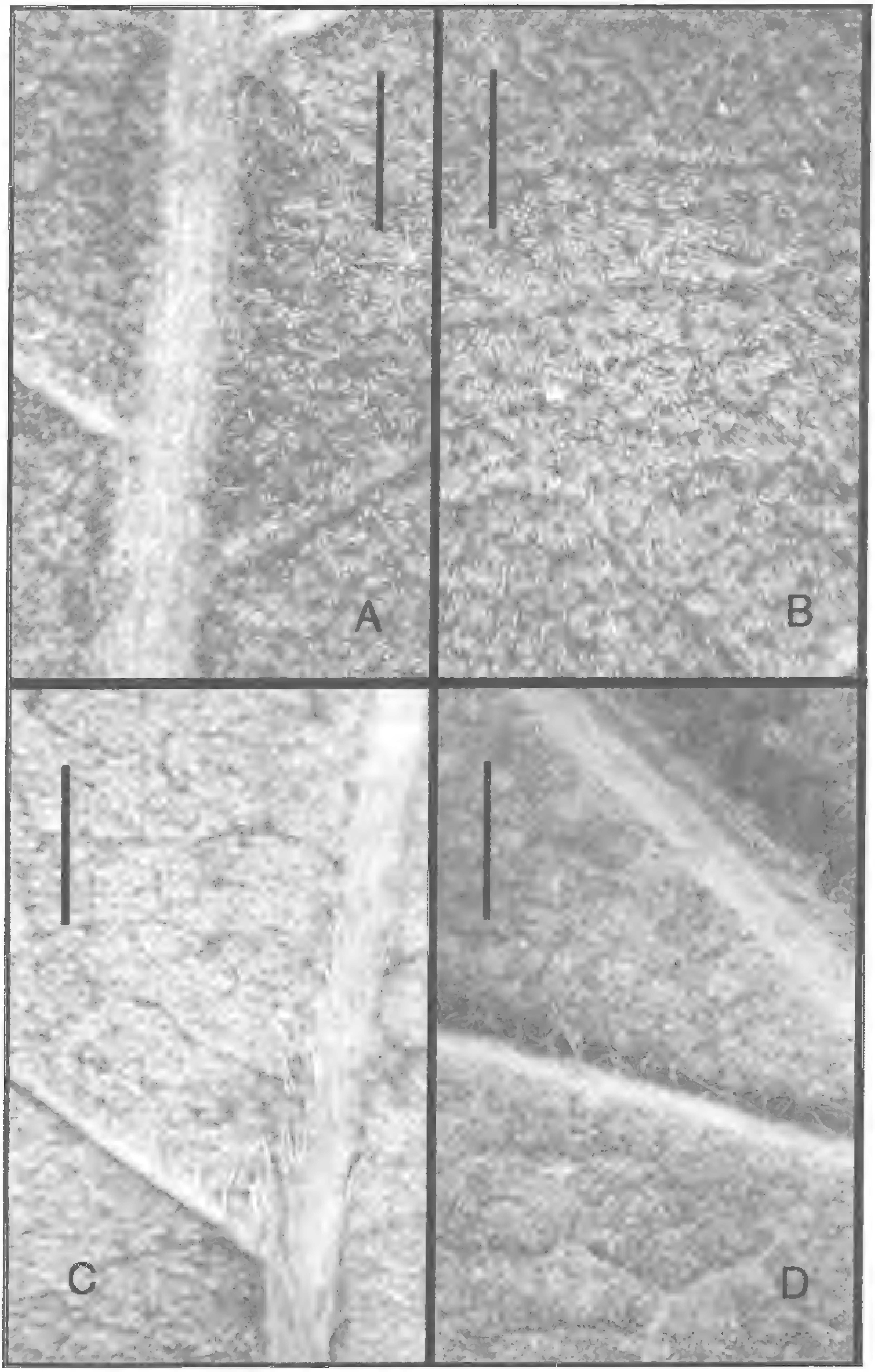


Fig. 21. Abaxial leaf surfaces of *D. acapulcensis* (scale = 1 mm). **A.** subsp. *mejocotensis,* including midrib (from the holotype). **B.** subsp. *mejocotensis,* with detail of epidermis (from the holotype). **C.** subsp. *dwyeri,* including midrib (from the holotype). **D.** subsp. *rivensis* (pale-leaved form), including midrib, from *P. Moreno & J.C. Sandino 6185* (MO).

the apex or along the margins, sericeous inside, the intramarginal band of moderate width. **Fruit** globose, slightly compressed or umbilicate, 2–2.5 cm in diameter, scantily hairy except at apically where densely hairy, epidermis often glaucous-pruinose and scintillant, yellow to light brown, sometimes light reddish-brown, probably golden brown when ripe. **Seeds** 15–16 mm long, 6–7 mm radial depth, 5 mm wide.

This subspecies occurs below 1240 m in tropical deciduous forests, semideciduous forests, and pine forests of El Salvador, Guatemala, Veracruz, Oaxaca, and Chiapas, Mexico (Figs. 23, 24). It has straight, appressed, strictly distally oriented abaxial lamina hairs, versus the straight to wavy, ascending to upright, not strictly distally oriented hairs of *D. a.* subsp. *acapulcensis*. Furthermore, compared to *D. a.* subsp. *acapulcensis*, the leaves of *D. a.* subsp. *veraecrucis* also tend to be slightly longer and narrower relative to length, especially at quarter length. The fruiting inflorescences of some specimens from El Salvador have peduncles 9–13 mm long with aborted lateral flowers that resemble long fruiting pedicels (e.g., *Monro 3576, M.A. Renderos 385*).

There is some suspicion that this taxon should be recognized at the species level, and we considered accepting *Diospyros veraecrucis* Standl. circumscribed so as to include three additional subspecies, all with rather straight, strongly appressed to ascending hairs on the abaxial leaf surface and/or abaxial midrib (e.g., subsp. *chiquimulensis*, subsp. *rivensis*, subsp. *dwyeri*). While we have not seen intermediates between *D. a.* subsp. *veraecrucis* and *D. a.* subsp. *acapulcensis* from regions where their distributions closely approach one another in Chiapas, Mexico, we are also not aware of these taxa occurring together. In the southern part of its range *D. a.* subsp. *veraecrucis* seems to intergrade with *D. a.* subsp. *rivensis* on an island off the coast of southern Honduras. Collections of the complex are lacking from the region between this island and populations of *D. a.* subsp. *veraecrucis* in El Salvador. In turn, *D. a.* subsp. *rivensis* forms intermediates with taxa that have curly or wavy hairs, or hairs not strongly ascending (e.g., *D. a.* subsp. *nicaraguensis*). Consequently, we are following a conservative course in recognizing this taxon only at the subspecific level.

Representative specimens. **GUATEMALA. Esquintla:** Finca Sabana Grande, 550 m, 15 Sep 1997, *M. Nee et al. 47265* (BM); 4 km S of Palín, 7 Aug 1970, *W.E. Harmon & J.D. Dwyer 2945* (UMO). **EL SALVADOR. Ahuachapán:** San Francisco Menéndez, El Corozo, Mariposario, 380 m, 21 Jan 2000, *J.M. Rosales 88* (MO, BM); P.N. El Imposible, 14 Apr 1999, *R. Villacorta & W. Beredsohn 2884* (MO, BM); vicinity of Ahuachapán, 800–1000 m, 9–27 Jan 1922, *P.C. Standley 20328* (MO). **Cabanas:** Cinquera, zona protegida, 380 m, 15 Apr 2002, *R.A. Carballo et al. 206* (MO). **La Libertad:** Canton Guadalupe, 400 m, 27 Nov 1999, *A.K. Monro et al. 3097* (MO, BM); Area protegida San Juán Buenavista, 320 m, 12 Oct 2000, *R.A. Carballo et al. s.n.* (MO); Lavas de Quezaltepeque, 620 m, Dec 1987, *M. Calderón JBL-00582* (MO). **San Salvador:** orilla del Lago de Ilopango, 442 m, 11 Dec 1997, *M.A. Renderos 385* (BM). **Santa Ana:** San José Ingenio, P.N. Montecristo, en el jocotón, 14°25'N, 89°21'W, 1120 m, 24 Sep 2001, *E. Ramos 90* (MO); San José Ingenio, P.N. Montecristo, la vuelta de los pinos, 14°25'N, 89°21'W, 600 m, *V.M. Martínez 240* (MO). Cooperativa Las Lajas, 1240 m, 28 Nov 2000, *A.K. Monro et al. 3576* (MO, BM). **Sonsonate:** Finca Las Victorias, 890 m, 25 Nov 2000, *A.K. Monro et al. 3552* (BM). **MEXICO. Chiapas. Mpio. Acapetahua:** La Encrucijada, 0 m, 26 Jan 1981, *V. Rico-Gray & I. Espejel 329* (XAL). **Mpio. Arriaga:** Río Las Arenas, 15 km NW of Arriaga, 130 m, 27 Aug 1974, *D.E. Breedlove 36833* (MO). **Mpio. Cintalapa:** 3–5 km N of Cintalapa, 900 m, 22 Dec 1972, *E.E. Breedlove & R.F. Thorne 30519* (MO). **Mpio. Mapastepec:** Guadalupe Victoria, 180 m, 22 Nov 1977, *J.I. Calzada et al. 3986* (XAL). **Mpio. Ocozocoautla de Espinosa:** near Derna, 800–1000 m, 16 Dec 1972, *D.E. Breedlove & R.F. Thorne 30360* (MO); 15 km WNW of Ocozocoautla, 800 m, *D.E. Breedlove 28994* (MO). **Mpio. Siltepec:** Fraylesca, 8 Mar 1945, *E. Matuda 5228* (F). **Mpio. Tapachula:** Santa Clara, 100 m, 9 Aug 1984, *E. Ventura & E. López 133* (XAL, MO). **Oaxaca. Mpio. Barrio de la Soledad:** 2 km S de Almoloya, 10 Dec 1980, *R. Cedillo T. & D. Lorence 495* (ILL). **Mpio. Matías Romero:** Campo Nuevo, 28 Apr 1981, *R. Cedillo T. 714* (MO). **Mpio. San Miguel Chimalapa:** 3 km al S de San Miguel Chimalapa, 22 Nov 1983, *R. Torres C. 4132* (MO, CHAPA). **Mpio. San Miguel del Puerto:** 1.6 km al W de Xadani, 500 m, 27 Oct 2001, *A. Saynes V. et al. 2642* (TEX); Finca El Istmo, 790 m, 1 Jan 2001, *A. Saynes V. et al. 2342* (TEX). **Mpio. Santa María Chimalapa:** ca. 6 km en línea recta al NE de Benito Juárez, 1000–1100 m, 3 Sep 1986, *S. Maya J. 3799* (UCR). **Mpio. Santo Domingo Tehuantepec:** "El Mangito," 11.1 km SW de Buenos Aires, 800 m, 25 Nov 1983, *R. Torres C. 4180* (MO). **Veracruz. Mpio. Actopan:** Cerro de la Mesa (Sierra Manuel Diaz), 250 m, 30 Dec 1985, *R. Acosta P. & N. Acosta B. 199* (IEB); Sierra Manuel Diaz, 150 m, 5 Jul 1985, *R. Acosta P. & F. Vazquez B. 741* (XAL, XALU, IEB). **Mpio. Alto Lucero de Gutiérrez Barrios:** Laguna de San Agustin, 10 m, 25 Feb 1983, *C. Gutierrez B. 1304* (IEB). **Mpio. Apazapan:** 2–6 km SE of Emiliano Zapata, 250–400 m, 27 Jun 1980, *B.F. Hansen & M. Nee 7503* (NO, USF, MU, WIS); same location and date, *B.F. Hansen & M. Nee 7482* (FLAS, MO, USF, UMO). **Mpio. Atoyac:** 5 km S de Caballo Blanco, 350 m, 22 Aug 1985, *R. Acevedo R. & F. Vazquez 440* (IEB). **Mpio. Axocuapan:** Ejido Coetzalan, alt 500 m, 6 Nov 1982, *L. Robles H. 358* (IEB). **Mpio. Catemaco:** Isla Agaltepec, lado NW, 24 Apr 1974, *F. Ponce C. & C. Alvarez C. 296* (CHAPA). **Mpio. Comapa:** Barranca de Panoaya, 450 m, 12 Dec 1985, *M.E. Medina A. & M. Ortiz D. 827* (IEB, XAL). **Mpio. Covarrubia:** cerca de Los Mangos, 17 Jan 1972, *R. Hernandez M. 1351* (CHAPA). **Mpio. Dos Ríos:** Plan del Río, 250 m, 25 Jul 1974, *F. Ventura A. 10390* (IEB). **Mpio. Emiliano Zapata:**

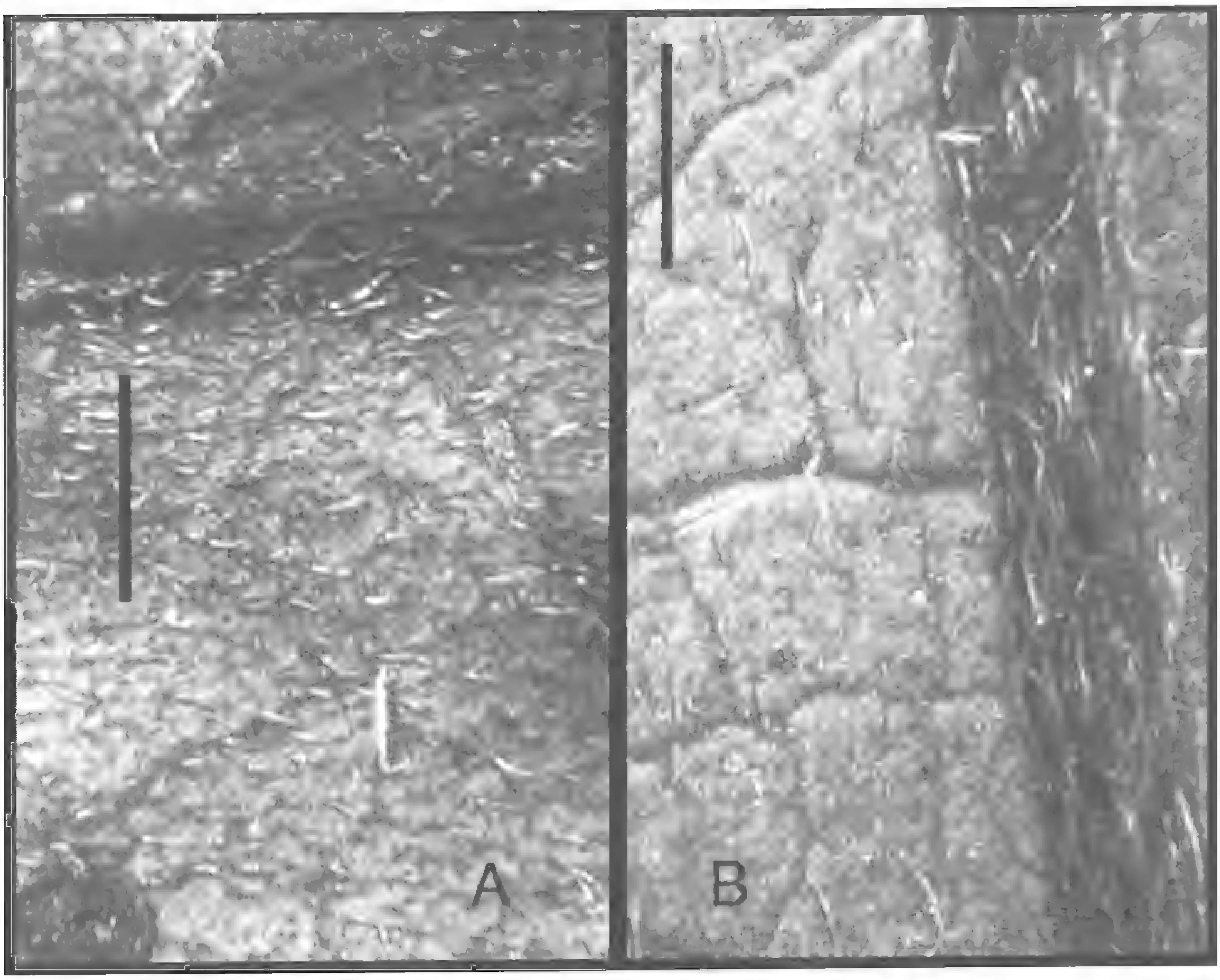


Fig. 22. Abaxial leaf vestiture, including midrib, of *D. acapulcensis* subsp. *rivensis* (scale = 1 mm). A. including nectary (from the holotype). B. *B. Hammel & C. Cano 19581* (K).

Corral Falso, 850 m, 30 Jun 1979, *L. Pacheco & J.I. Calzada 9* (IEB); same location, 17 Jan 1973, *M. Cházaro B. & J. Dorantes 19* (XAL). **Mpio. La Antigua:** Rincón del Pirata, 30 m, 19 Nov 1982, *P. M. Casasola et al. BD-1168* (MO). **Mpio. Medellín:** Paso del Toro, 18 Jan 1990, *P. Zamora C. 1929* (IEB). **Mpio. Naolinco:** cerca de Almolongas, 950 m, 25 Apr 1992, *M. Cházaro B. et al. 6908* (IEB, MO). **Mpio. Paso de Ovejas:** 2 km SW de Cantarranas, 200 m, 30 Jan 1985, *G. Castillo C. & M.E. Medina A. 3551* (XAL, XALU, IEB). **Mpio. Puente Nacional: Chichicastle:** 50 m, 10 Dec 1976, *F. Ventura A. 13729* (IEB). **Mpio. San Andrés Tuxla:** Laguna Encantada, 300 m, 2 Jul 1982, *M. Nee et al. 24761* (BH, USF, WIS). **Mpio. Tamiahua:** E de Laguna Salada, 5 m, 26 Jun 1972, *J. Dorantes et al. 1076* (MO). **Mpio. Tonalá:** NW of Puerto Arista, 3m, 19 Oct 1971, *D.E. Breedlove & R.F. Thorne 20869* (CHAPA, MO). **Mpio. Xalapa:** San Antonio, 800 m, 4 Feb 1975, *F. Ventura A. 10911* (UMO).

2. Diospyros aequoris Standl., Publ. Carnegie Inst. Wash. 461:80. 1935. (**Fig. 25**). *Maba latifolia* Standl. Contr. U.S. Natl. Herb. 18:118. 1916. Type: MEXICO. Sinaloa. [Mpio. Culiacán]: "Collected in the vicinity of Guadalupe" [as on label], "dry coastal thickets" [protologue], [24°15'N, 107°19'W, 3 m], 18 Apr 1910, *J.N. Rose, P.C. Standley & P.G. Russell 14709* (holotype: US-637592; isotypes: MO, internet image!, C!). Not *Diospyros latifolia* Gürke, Bot. Jahrb. Syst. 26:63. 1899.

Trees, shrubs, or multi-stemmed clones from root and crown sprouts, 1–8(–12) m tall, facultatively deciduous, dioecious; **trunk** recorded up to 30 cm in diameter, bark nearly smooth (but not slick), irregularly roughened, or irregularly scaly, sometimes fissured or checked, especially at major branch forks, coloration sometimes patchy, usually grayish; **wood** hard, cream to dark yellow, dried branch wood light yellow to golden brown, slash nearly white to light yellow, usually yellowish after several minutes, sap clear; **mature stems** terete, smooth or fissured to half-netted, sometimes somewhat checked, glabrous to scurfy, epidermis often shiny or viscid, variously colored, but mostly beige, reddish-brown, grayish, or castaneous,

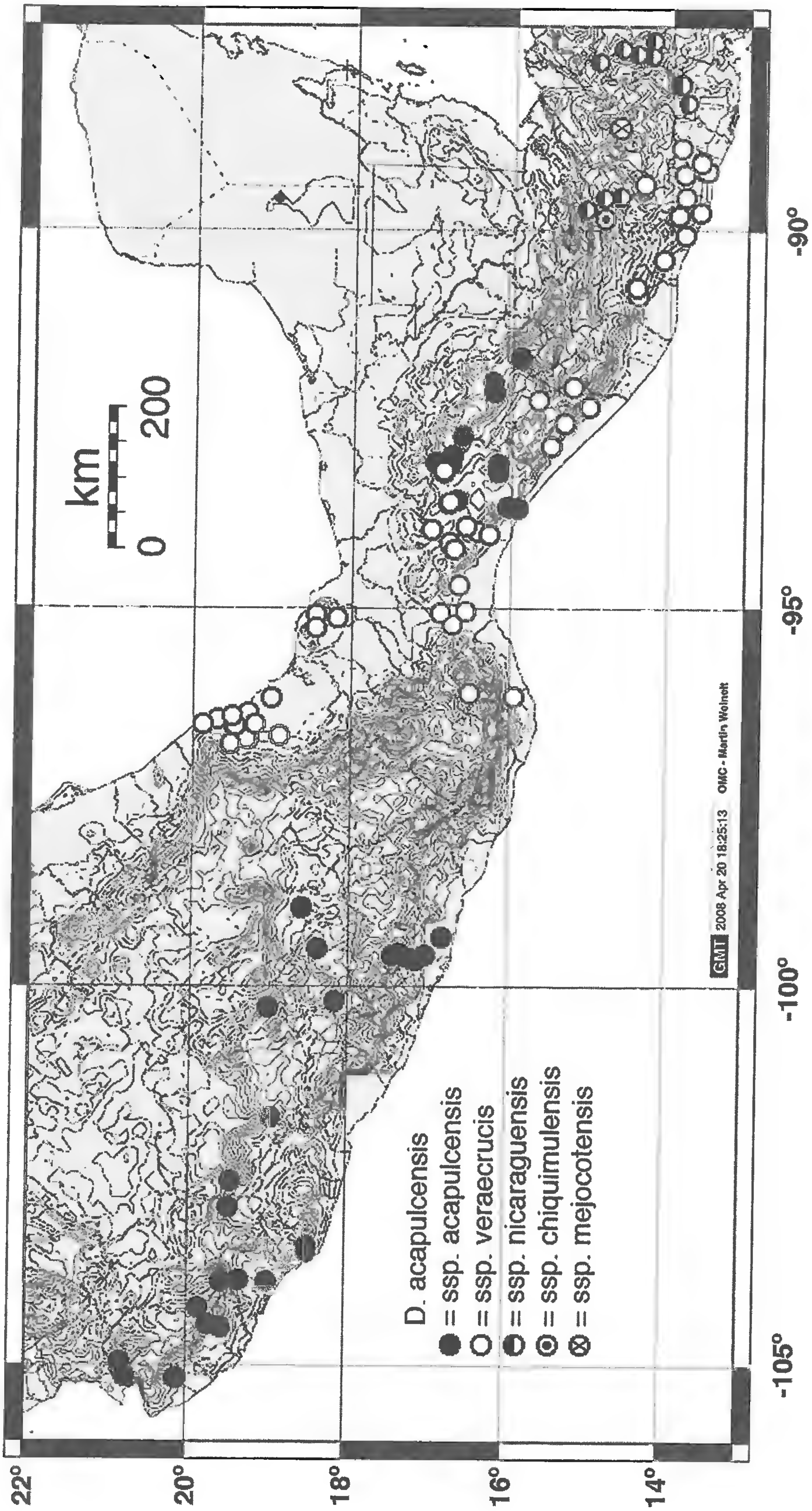

km
0
200
D. acapulcensis
● = ssp. acapulcensis
○ = ssp. veraecrucis
◐ = ssp. nicaraguensis
◎ = ssp. chiquimulensis
⊗ = ssp. mejocotensis
GMT 2008 Apr 20 18:25:13 OMC - Martin Weinelt
22°
20°
18°
16°
14°
-105°
-100°
-95°
-90°

Fig. 23. Distribution of *Diospyros acapulcensis* in Mexico and NW Central America.

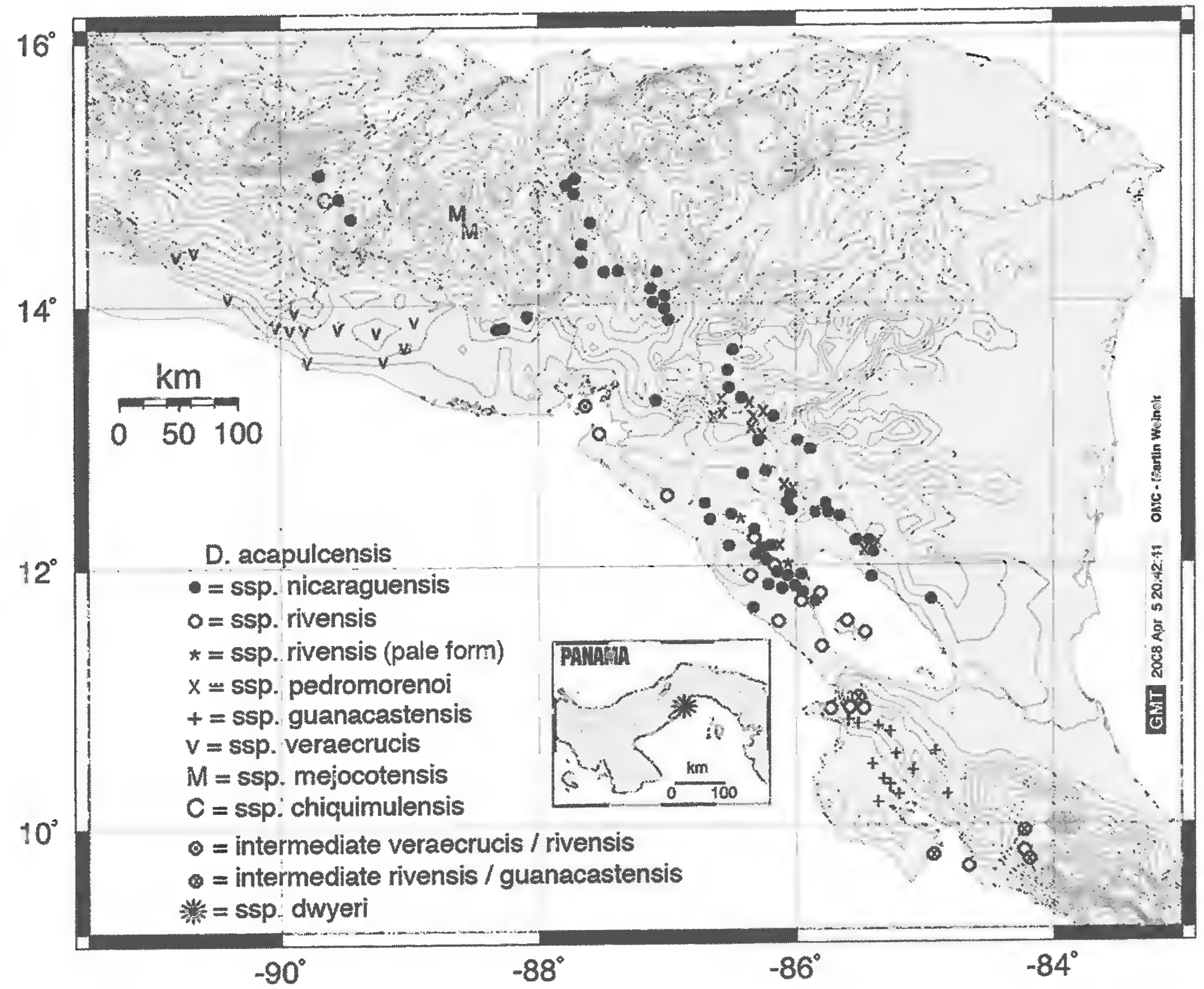

16°
14°
12°
10°
-90°
-88°
-86°
-84°
km
0 50 100
D. acapulcensis
● = ssp. nicaraguensis
○ = ssp. rivensis
* = ssp. rivensis (pale form)
x = ssp. pedromorenoi
+ = ssp. guanacastensis
v = ssp. veraecrucis
M = ssp. mejocotensis
C = ssp. chiquimulensis
⊙ = intermediate veraecrucis / rivensis
⊗ = intermediate rivensis / guanacastensis
✺ = ssp. dwyeri
PANAMA
km
0 100
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Fig. 24. Distribution of *Diospyros acapulcensis* in Central America.

black gland-dotted, usually lenticellate; **2nd year stems** subterete to terete, sometimes angular, striate to half-netted, often glabrous, or the persisting vestiture desiccated and ashy or covered with exudate, sometimes hispidulous with scattered longer hairs, epidermis coloration variable, minute round cream lenticels commonly present; **1st year stems** angular to terete, smooth or striate to sulcate, densely hairy, the hairs variously straight to curly, minute to about 2 mm long, ascending to spreading, sometimes twisted, clear or white to reddish (the hairs throughout the plant are mostly simple glandular hairs, translucent in life, and the color of hairs in herbarium specimens is due to darkening of a fluid in the lumen), clavate glandular hairs often present, deciduous, leaving the orangish to dark brown (green in life) epidermis viscid. **Leaves** alternate, simple, entire; **petioles** subterete to terete, sometimes broader and flattened or caniculate above, 1.5–6(–7) mm long, margin usually not winged, but sometimes distally so, densely hairy, the hairs as variable as those described for 1st year stems except sometimes subappressed, epidermis smooth to rugose, coloration highly variable, often shiny and viscid; **lamina** chartaceous to subcoriaceous, 18–80(–100) mm long, 12–40(–54) mm wide, length to width ratio 1.1–2.8(–3.2) : 1, usually elliptic, oblong, or oval, *base* mostly rounded to very widely rounded to the petiole (length to width ratio at 1/4 lamina length 1.5–4.3 : 1), clavate glandular hairs often present, but deciduous, the coloration of the epidermis in dry material variable, often darker above than below, *margin* flat to revolute, sometimes undulate, *apex* usually rounded, often widely (leaf length to leaf width at 0.75 length 1.3–3.5 : 1); **lower lamina surface** moderately to densely hairy, the hairs straight, wavy, or curly, minute to 2 mm long, subappressed to upright, white to

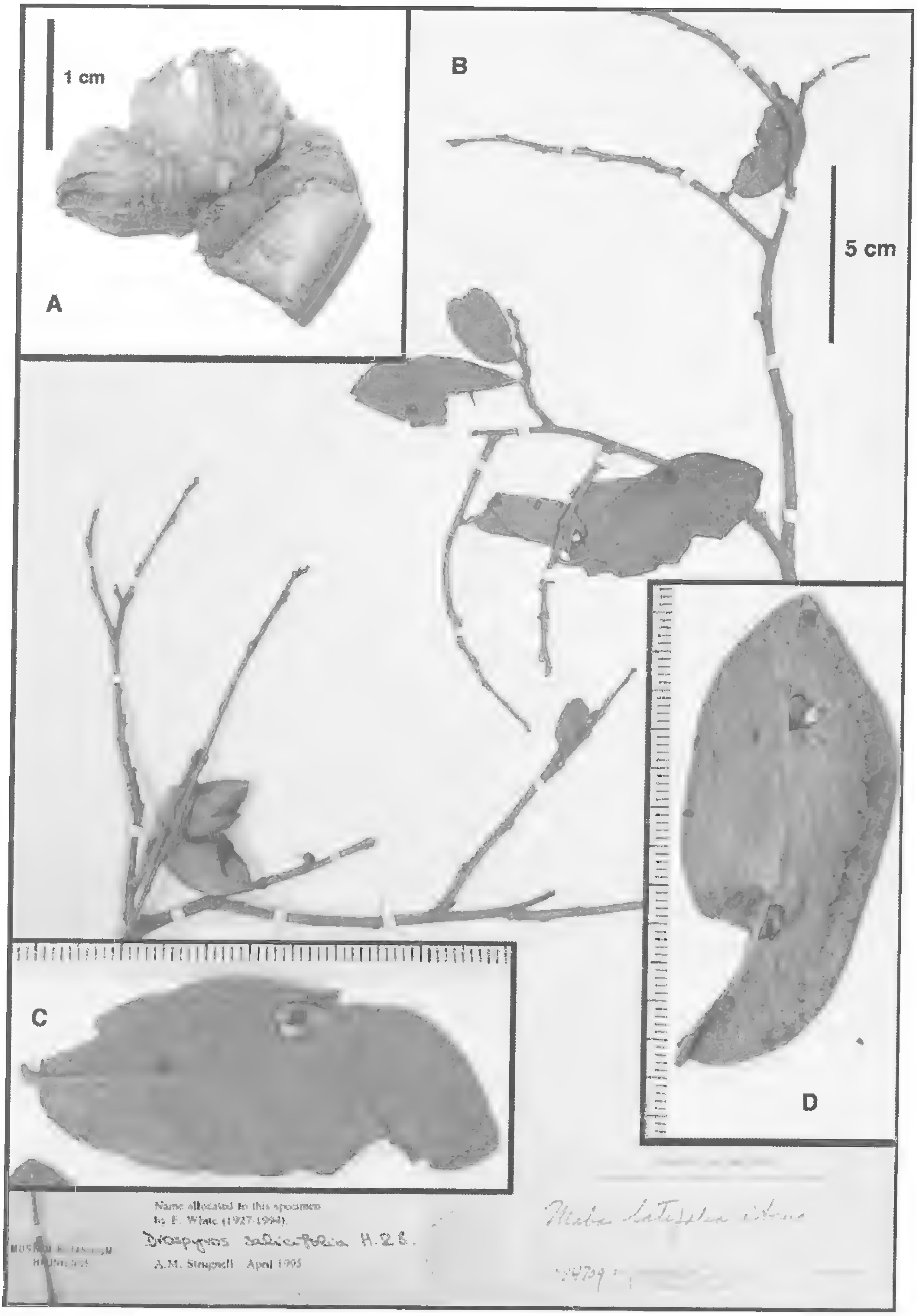
1 cm
A
B
5 cm
C
D
Name allocated to this specimen
by F. White (1927-1994).
Diospyros salicifolia H.&B.
A.M. Strugnell April 1995
Maba latifolia Hook
14709

Fig. 25. Isotype of *D. aequoris* Standl. from the vicinity of Guadalupe, Sinaloa (*J.N. Rose et al. 14709*, C). A. Fruiting calyx. B. Leafy and fruiting branchlets. C. Abaxial leaf surface D. Adaxial leaf surface.

dark reddish-brown, vestiture often a mixture of hair types, sometimes deciduous, sometimes persistent and forming patches of desiccated or exudate covered hairs, epidermis dull to shiny or viscid, the stomatal apparatus often opaque, off-white, and conspicuous; **upper lamina surface** usually wrinkled, usually moderately to densely hairy, the hairs as variable as described for the lower lamina surface except usually tending to be erect, often deciduous, the base of the hair sometimes thickened or raised, and forming a seeping annular gland when the rest of the hair falls, the epidermis often shiny and viscid, sometimes crystal-papillose (Fig. 26). **Venation** arcolanguid to brochidodromous, sometimes eucamptodromous, sometimes obscured by the vestiture; **midrib** prominent below, usually densely hairy, but often becoming glabrous, impressed to flush above, sometimes slightly raised near the base, sparsely to densely hairy, the hairs straight to wavy, ascending to upright, clavate glandular hairs sometimes present, sometimes furfuraceous; **lateral veins** (3–)4–9 on each side of the midrib, the course usually tending to arc towards the apex of the leaf with minor inflections, the vestiture and epidermis usually similar to that of the midrib, prominent below, stout to fine, impressed to barely raised above, usually impressed slightly along the lamina-vein seam, sometimes obscure; **3° veins** apparent to prominent below, fine to stout, impressed to obscure above. **Laminar extrafloral nectaries** abaxial, mostly round to oblong, usually 0.3–0.5 mm long, sometimes minutely rimmed, more common in the proximal 1/2 and close to the midrib. **Male inflorescences** solitary 2–3-flowered cymes, or solitary flowers in leaf axils of young stems (usually new growth), densely hairy, the hairs as variable as those described for the lower lamina surface; **peduncles** 0.5–3 mm long; **pedicels** 0.8–5 mm long, bracts deltoid to linear-lanceolate, minute to 2 mm long. **Male flowers** 3–4-merous, ± pendant; **male flowering calyx** narrowly urceolate to narrowly campanulate, sometimes slightly winged, exterior densely hairy, the hairs minute to short, straight to curly, ascending, off-white to golden or tawny, clavate glandular hairs sometimes present, deciduous, leaving the epidermis viscid, light green in life, *tube* 2–4 mm long, 3–4 mm wide, interior usually glabrous, sometimes with scattered to sparse hairs, *lobes* valvate-reduplicate in the bud, acute, 3–6(–7) mm long, 2.5–5(–5.5) mm wide, sometimes with a central keel, exterior densely hairy, interior intramarginal band of hairs variable in width, comprised mostly of minute, curly, off-white to tawny, golden, or reddish hairs, the median glabrous to sparsely hairy, the hairs minute to short, straight to slightly wavy, appressed; **male corolla** white to cream in life; **male corolla tube** salverform to narrowly urceolate or cylindrical, sometimes narrowing distally, 4.5–6.5 mm long, 3–4 mm wide, with three shield-shaped, 0.3–2 mm long, glabrous zones at the base, or sometimes the basal part of the tube completely glabrous, otherwise sericeous with an undercoat of minute curly to straight hairs, minute hairs sometimes present between the sericeous and glabrous zones; **male corolla lobes** spreading in life, lanceolate to ovate, elliptic, oblong, or rhombic, 2–4 mm long, 0.8–2.5 mm wide, densely hairy, the hairs minute, curly to wavy (and then upright), or straight and appressed, especially along the left side, sometimes straight and nearly retrorse or going in random directions, especially along the right margin, the median sometimes raised outside, sericeous, at least basally, margins sometimes involute, especially near the base. **Stamens** 9–12; **filaments** adnate to the tube in 1–2 well-defined tiers or somewhat irregularly, often with some (rarely all) inserted on the receptacle, sometimes geminate, rarely filaments adjoined laterally; **anthers** mostly lanceolate, sometimes oblong, 2–2.7 mm long, sometimes 'eared' (with a minute lobe at the base of the anther on each side of the connective), opening by longitudinal slits. **Pistillode** usually minute, densely hairy, the hairs straight to wavy, lustrous. **Female inflorescences** solitary in leaf axils of young (often 1st year) stems, densely hairy, the hairs and epidermis similar to those seen for male inflorescences; **female flowering pedicels** with hairs and epidermis similar to male inflorescences. **Female flowers** 3–4-merous; **female flowering calyx** mitriform, campanulate to broadly campanulate, exterior densely hairy, the vestiture a variable mixture of short hairs and long hair types, the longer hairs sparse, *tube* usually cupulate, sometimes half-globose, (1.5–)2.3–6 mm long, 3–7 mm wide, *lobes* valvate-reduplicate in the bud, winged, usually broadly rounded to subacute, sometimes acute, 3–8 mm long, 4–8 mm wide, abruptly acuminate or bluntly acute, major nerves sometimes conspicuous; **female corolla** white to cream in life; **female corolla tube** urceolate or short urceolate to subcylindrical, usually narrowing distally, 4–7.5

mm long, (2.5–)3–4 mm wide, exterior vestiture similar to that described for male corolla tubes, interior glabrous; **female corolla lobes** spreading in life, ovate to rhombic, sometimes oblong, (2.5)3–4 mm long, 1.8–2.5 mm wide, often glabrous near the exterior margins, the median often broadly raised outside, often partly involute, exterior vestiture similar to that of male flowers, interior glabrous, sometimes with a longitudinal depression through the center; **ovary** obturbinate, ovoid, globose, ± depressed-globose or somewhat conical, usually about 2 mm in diameter, glabrous to densely hairy, the hairs straight, white, blond, cream, tan tawny, or reddish, sometimes dimorphic; **styles** 3, spreading or fused into a column, 1.8–2.5 mm long, usually with minute appressed hairs on the exterior, interior sometimes with some minute wavy hairs; **stigmas** vaguely bifid to conspicuously v-shaped, rarely trifid; **staminodes** 0–6, adnate to the base of the corolla tube or inserted on the receptacle, narrowly lanceolate, rarely ovate, 2–4.5 mm long. **Fruiting pedicels** terete to angular, sometimes stout, often broader distally, 2–8(–12) mm long, subglabrous to densely hairy, the hairs usually wavy to curly, often covered with exudates, clavate glandular hairs sometimes present, deciduous, leaving the light orange to dark reddish-brown epidermis viscid, bracts 1–2, opposite to subopposite, linear to ovate, 1.5–4 mm long, concave to conduplicate. **Fruiting calyx** slightly accrescent, cupulate to explanate, sometimes tearing at the sinus along a zone of dehiscence, exterior vestiture as described for flowering calyces or glabrate, often with pale desiccated remnants of the original vestiture, epidermis often conspicuously viscid and darkened, *tube* (3–)3.5–6.5(–8.5) mm long, interior glabrous to hairy in the upper 1/2–2/3, the hairs usually straight and appressed, *lobes* obtuse to rounded, overall similar to the calyx lobes of female flowers except wider, rarely acute, 3–8(–9) mm long, (6–)6.5–15 mm wide, reflexed (basally, near the apex, or along the margins), interior intramarginal band of hairs variable in width, the hairs similar to those described for the intramargin of the male calyx, the median usually hairy, the hairs usually straight and appressed. **Fruit** a globose to subglobose or obovoid berry, 1.5–2.5 cm in diameter, consistently with three pairs of locules, glabrous to sparsely hairy, sometimes moderately hairy at the base, often densely hairy at the apex, the hairs slightly wavy to straight, a basal ring of subappressed, fine, straight hairs sometimes present (the ring may adhere to the base of the fruiting calyx tube); **flesh** gelatinous, drying vitreous, reddish and translucent; **epidermis** smooth to orange-peeled or wrinkled, sometimes separating from the fruit wall upon drying, sometimes glaucous, pruinose or scintillant, mature fruit light grayish-yellow to golden brown, green in life, golden brown when ripe. **Seeds** shaped like an orange segment, texture rugulose-foveolate, 11–17 mm long, 6–9 mm radial depth, 5–7 mm wide.

KEY TO THE SUBSPECIES OF *DIOSPYROS AEQUORIS* IN MESOAMERICA

1. Lamina orbicular to oblong or obovate, length : width ≤ 1.6 : 1, base subcordate to rounded, length : width at 0.25 < 2.2 : 1, length : width at 0.75 < 1.7 : 1, margin flat, hairs below fine, soft, glossy, white, sometimes gold; stems atropurpureous; fruiting calyx tube ≥ 5 mm long; mostly trees; Apatzingan Valley, Michoacan, Mexico ________ subsp. **martineziana**
1. Lamina shape variable, but length : width usually > 1.6 : 1, base not subcordate, length : width at 0.25 > 2.2 : 1, length : width at 0.75 > 2.2 : 1, margin often revolute, hairs below not as above; stems light gray to atropurpureous; fruiting calyx tube < 5 mm long; trees or shrubs; Sinaloa to Oaxaca, W Mexico.
    2. Fruit epidermis weakly attached to the fruit wall, often separated in dry specimens, dull light yellow; lamina rhombic, oval, elliptic or oblong, the hairs below cream to yellowish, later ashy; fruiting calyx small (calyx length + lobe width 15–20 mm), the lobes reflexed near the apex; E Michoacan and adjacent regions of Mexico and Guerrero ________ subsp. **balsensis**
    2. Fruit epidermis strongly attached to the fruit wall, usually not separated in dry specimens, not dull light yellow; lamina rarely rhombic, hairs below variously colored; fruiting calyx small to large (calyx length + lobe width 16–28 mm), the lobes reflexed or not; W Mexico.
        3. Lamina chartaceous, not coarsely wrinkled, the margins undulate, not revolute, hairs above deciduous, leaving a seeping glandular area, 2° venation eucamptodromous, 3° venation slightly raised below, inconspicuous above; fruiting pedicels 2.5–4 mm long; coastal W Guerrero, Mexico ________ subsp. **chutlensis**
        3. Lamina subcoriaceous and usually coarsely wrinkled when mature, the margins often revolute, not markedly undulate, hairs above sometimes deciduous, usually not leaving conspicuous seeping areas, 2° venation brochidodromous, 3° venation prominent below, impressed above; fruiting pedicels 2–8(–12) mm long; fruiting calyx small to large; Oaxaca, Jalisco, Nayarit, Sinaloa, Mexico.

4. Fruiting pedicels mostly 5.5–12 mm long; fruiting calyx large, the lobes 11–14 mm wide; lamina usually > 65 mm long, petioles usually > 4 mm long; known only from coastal Oaxaca ____ subsp. **rekoi**
4. Fruiting pedicels mostly 2–5.5 mm long; fruiting calyx small to large, the lobes 6–15 mm wide; lamina usually < 65 mm long, petioles often < 4 mm long; interior Oaxaca, Sinaloa, Nayarit and coastal Jalisco, Mexico.
   5. Lamina bright green to beige or reddish-brown above and below, vestiture below, including the midrib, usually a mixture of curly or kinked hairs with some longer slightly wavy to straight, subappressed hairs, venation below very prominent, greenish to beige, brick red or reddish-brown; plants of Sinaloa, Nayarit and coastal Jalisco, Mexico ____ subsp. **aequoris**
   5. Lamina greenish-gray to gray above and below, vestiture below, including midrib, of wavy to straight hairs, venation below prominent, cream to magenta or speckled with both colors; known only from interior Oaxaca ____ subsp. **tehuantepecensis**

2a. Diospyros aequoris Standl. subsp. aequoris (Figs. 25, 26, 27, 28, 38b).

Trees or shrubs, 1–4(–9) m tall; **trunk** grayish-white or gray to reddish-brown; **stems** glabrous, furfuraceous, or with remnant patches of desiccated hairs, young stems with short, dense, reddish curly hairs, and sparse long, straight, spreading to ascending hairs. **Petioles** cylindrical to semi-terete, 1.5–4 mm long, densely hairy, the hairs curly, sometimes nearly straight, ascending, reddish-brown, epidermis dark brown, viscid. **Lamina** subcoriaceous, rarely chartaceous, (20–)26–66(–77) mm long, 15–28(–34) mm wide, length to width ratio 1.7–2.7(–3.2) **:** 1, elliptic to obovate, rarely oval, gray to reddish-brown, darker above than below, *base* obtusely rounded, sometimes short-attenuate, *margin* revolute, *apex* obtusely to acutely rounded; **lower lamina surface** with dense reddish-brown tomentum, with some longer slightly wavy to straight, ascending to subappressed hairs, the vestiture deciduous, or becoming ashy and covered with exudate, clavate glandular hairs often present, the epidermis olive-green to brownish, the stomatal apparatus translucent to opaque, usually conspicuous; **upper lamina surface** wrinkled, subglabrous to curly-villosulous, the hairs deciduous, clavate glandular hairs often present. **Venation** brochidodromous, very prominent below, markedly impressed above; **midrib** subsericeous below, with sparse shorter curly hairs, the epidermis viscid, reddish, densely hairy above, the hairs wavy, ascending, furfuraceous, viscid; **lateral veins** 5–7(–8) per side, prominent below, subsericeous; **3° veins** prominent below, wavy-hairy. **Male inflorescences** solitary flowers, with dense minute cream to golden wavy hairs; **pedicel** 4–6 mm long, bracts minute, ± deltoid. **Male flowering calyx** urceolate to subcylindrical, with dense, ascending, cream to golden pubescence, *tube* 2–4.2 mm long, 3–4 mm wide, several straight, 1.5–2 mm long hairs inside near the base, shorter hairs scattered distally, *lobes* narrowly triangular, 3–5 mm long, 2.5–3 mm wide, with scant short vaguely wavy appressed hairs inside, the tomentose intramargin very narrow; **male corolla tube** 5.5 mm long, 3 mm wide, exterior cream to yellowish or reddish sericeous, with 3 shield-shaped glabrous basal regions, each 1.5 mm long; **male corolla lobes** lanceolate to rhombic, 2.5–4.5 mm long, 0.8–2.5 mm wide. **Stamens** 9–12; **filaments** adnate to the corolla in two distinct tiers, or all inserted on the receptacle, 1–1.5 mm long; **anthers** oblong-lanceolate, 2 mm long, sometimes 'eared' basally, vaguely granulate apically. **Female inflorescences** densely and minutely hairy. **Female flowering calyx** campanulate, sometimes broadly, densely reddish tomentulose outside, with some longer spreading hairs, epidermis reddish-brown, viscid, *tube* cupulate, 3–3.5 mm long, 4 mm wide, the upper 1/2 densely hairy inside, lower 1/2 glabrate, *lobes* obtuse, 6–8 mm long, 5–6 (7) mm wide, bluntly pointed to acutely rounded; **female corolla tube** 6 mm long, 2.5–3.3 mm wide, upper half white sericeous outside, lower half glabrous, drying dark red; **female corolla lobes** ovate to oblong, 3.5 mm long, 2.5 mm wide; **ovary** obturbinate to ovoid, minutely white to tan sericeous; **styles** 3, fused most of their length; **stigmas** 3, conspicuously v-shaped; **staminodes** 0–3, inserted on the receptacle, slender, 4.5 mm long, dark red. **Fruiting pedicels** 2–5(–8) mm long, densely tomentulose, clavate glandular hairs often present, epidermis reddish-brown or darker, bracts linear, 1.5 mm long, conduplicate. **Fruiting calyx** rotate to explanate, densely golden to reddish-brown tomentulose outside, with occasional longer straight hairs, glabrate, or the hairs desiccating, becoming ashy, and sticking to the viscid epidermis,

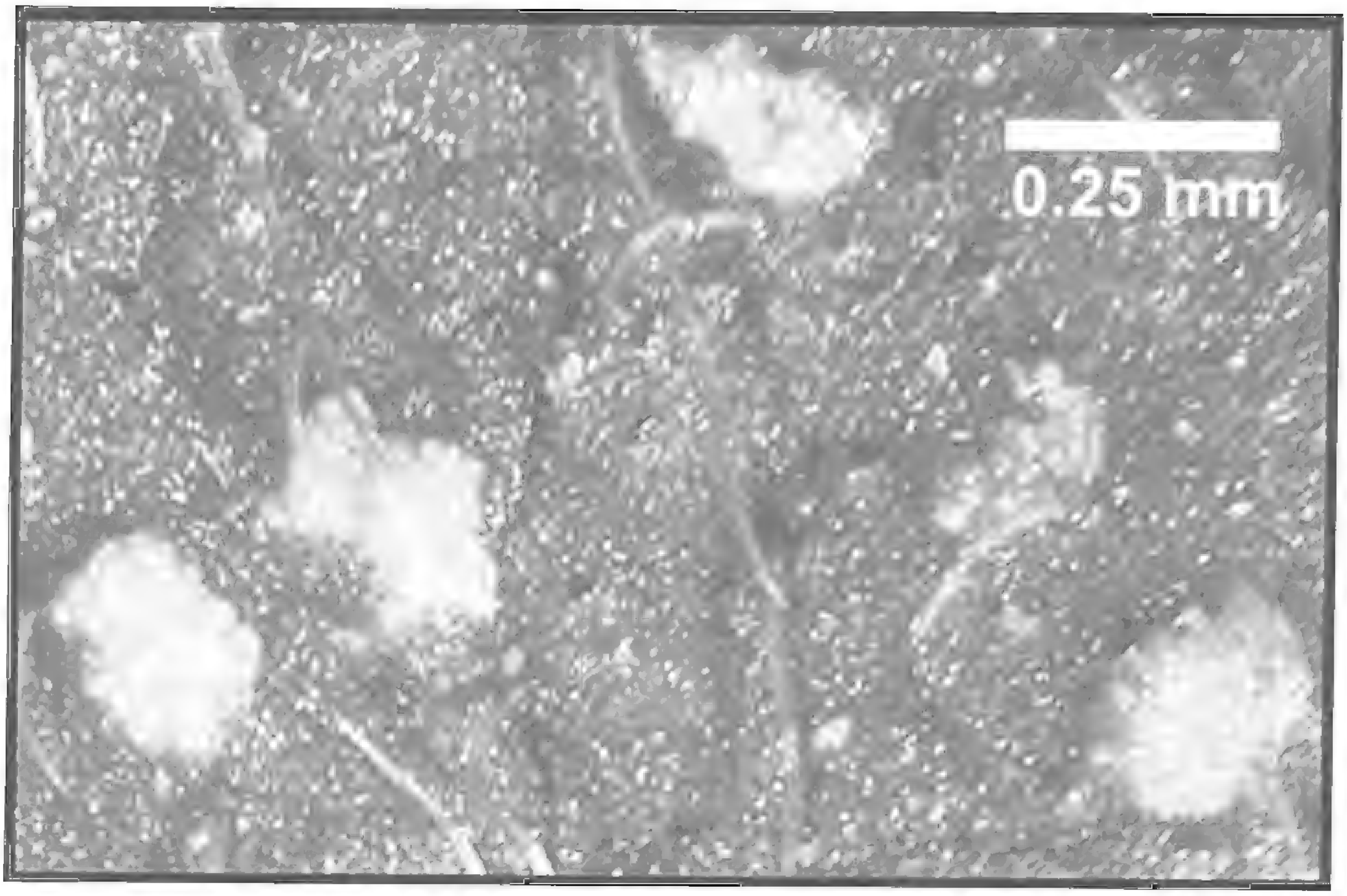

Fig. 26. Detail of adaxial lamina epidermis with aggregates of albescent excrescences (crystal-papillose) in *D. aequoris* subsp. *aequoris* (*Provance 9593*, UCR).

tube (3–)4–6.5(–9) mm long, the upper 1/2–2/3 hairy inside, lower 1/2–1/3 glabrous, *lobes* acute to slightly obtuse, (4–)5–7.5(–9) mm long, (6–)8–13(–15) mm wide, spreading, or sometimes reflexed near the apex, along the margins, or both, nerves often conspicuous, hairy inside, the interior intramarginal band wide. **Fruit** globose, 1.5–2.5 cm in diameter, densely ascending wavy-hairy basally and apically, glaucous-pruinose and scintillant, yellow to dark golden brown, sometimes black gland-dotted. **Seeds** 12–13 mm long, 6–7 mm radial depth, 5 mm wide.

This subspecies occurs in semi-arid oak forests on rocky soils in the Barranca Region of the west Durango-Sinaloa border region, on steep, rocky volcanic slopes with dry tropical forest in the foothills around Culiacan, on the coastal plains of Sinaloa in thornscrub and dry tropical forest or thornscrub transitioning to mangrove forest, and on inland mesas with *Krameria* in the northern extremity of Nayarit. Several, apparently disjunct, populations occur on and near the coast of Jalisco in the vicinity of the Bahia de Chamela (Fig. 40). Only two specimens with male flowers have been seen. In both cases the inflorescences consisted of solitary flowers in leaf axils of new growth, representing exceptions to the 3-flowered cymes typically seen in the complex. This subspecies is similar to *D. ae.* subsp. *tehuantepecensis* from inland Oaxaca, being separated by differences (see key) in leaf surface, abaxial leaf vestiture, and lamina color (at least when dry). Furthermore, ratio of leaf length to average distance between centermost lateral veins is significantly higher in *D. ae.* subsp. *aequoris* than *D. ae.* subsp. *tehuantepecensis*.

Representative specimens: **MÉXICO. Durango. Mpio. Tamazula de Victoria:** Sierra Tres Picos, [25°3'N, 107°1], 3000 ft,19 Dec 1939, *H.S. Gentry 5286* (NA, MO). **Jalisco. Mpio. La Huerta:** Rancho Cuixmala, 200–300 m, 5 Nov 1991, *E.J. Lott et al. 4159* (UCR). **Nayarit. Mpio. Huajicori:** Zonteco, 110 m, 30 Aug 2004, *M.C. Provance et al. 9606, 9607 & 9608* (UCR). **Sinaloa. Mpio. Badiraguato:** Cienegita, SE of Badiraguato, 2000 ft, 29 Mar 1940, *H.S. Gentry 5946* (NA, MO, ARIZ). **Mpio. Cosalá Vado Hondo:** a 14 km del poblado de Cosalá, 590 m, 9 Nov 1985, *A. García V. 172* (CHAPA). **Mpio. Culiacán:** ± 4 km al sur de Culiacán, 50 m, 1 Nov 1990, *R. Vega A et al.*

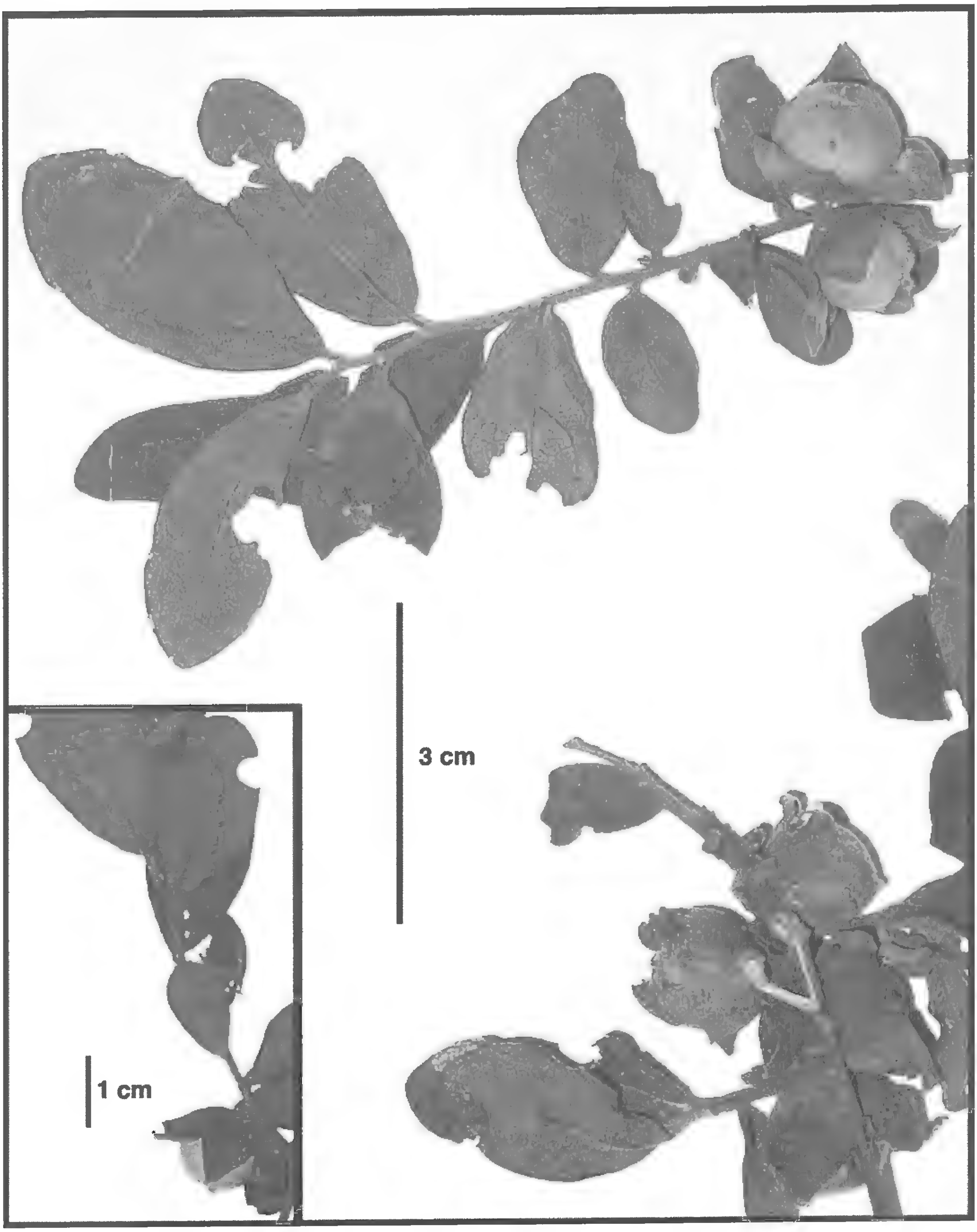

FIG. 27. *Diospyros aequoris* subsp. *aequoris* from 2 km SSW of Vigas Loma, Sinaloa (*M.C. Provance & J.S. Ross-Ibarra 9525*, UCR).

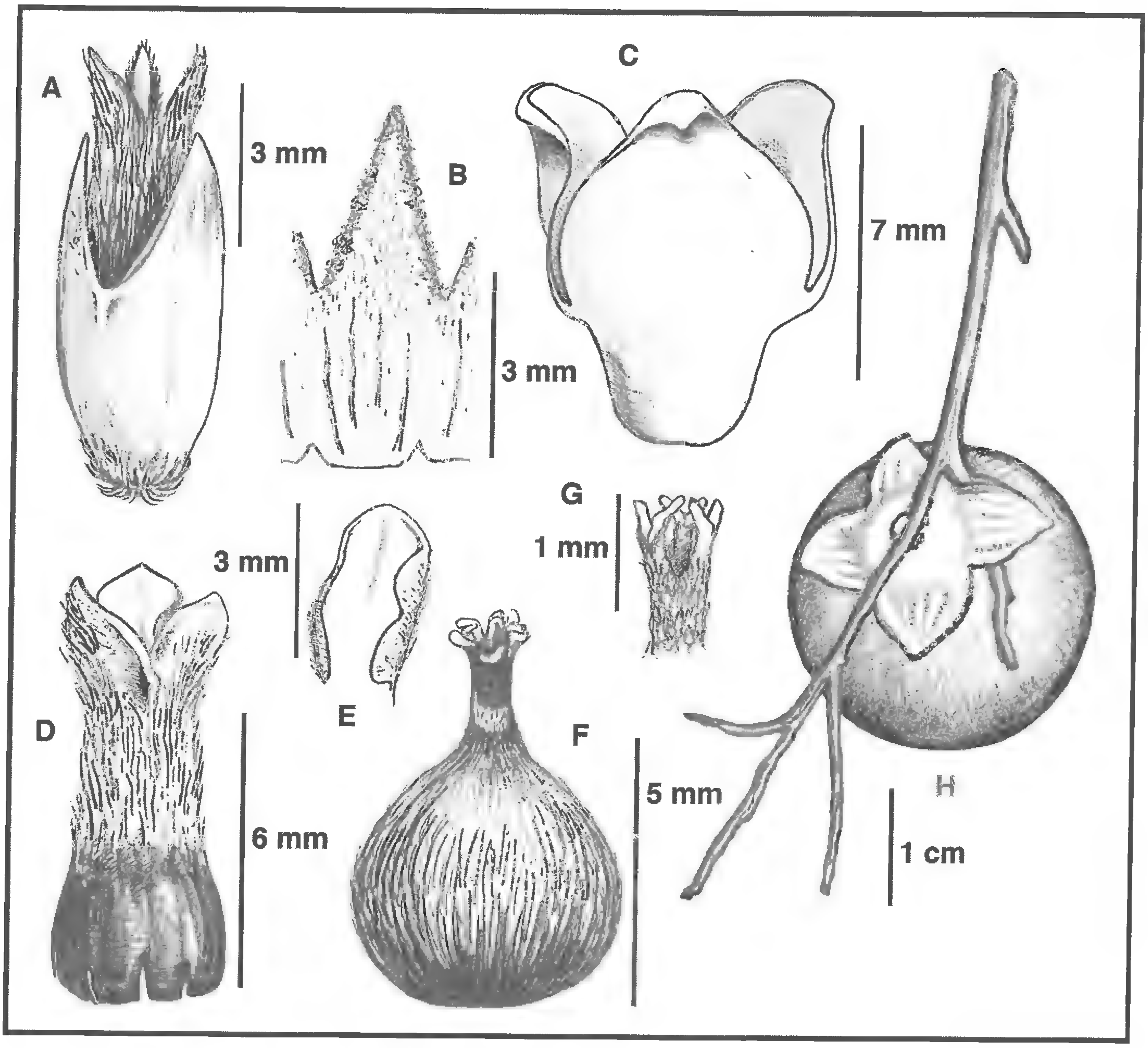

Fig. 28. *Diospyros aequoris* **subsp.** *aequoris*. **A–B. Male flower, based on *Provance et al* 9593, UCR. C–G. Based on *E. Guízar N. 3233* (CHAPA). C. Fruiting calyx. D. Female corolla. E. Female corolla lobe (adaxial side). F. Immature fruit. G. Detail of styles and stigmas. H. Mature fruit, based on *H.S Gentry 5946*, ASU.**

3972 (CIIDIR). **Mpio. El Rosario:** Playa de Chametla, ± 9 km S de Chametla, 10 m, 5 Nov 2004, *J.M. Aguilar P. 1608* (UCR); El Carrizo, ± 9 km al N de Cacalotán, 50 m, 6 Nov 2004, *J.M. Aguilar P. 1612* (UCR). **Mpio. Mazatlan:** Isla de la Piedra, 23 Jul 1994, *E. Guízar N. 3233* (CHAPA, IEB). **Mpio. Mocorito:** El Alamo, along road from Mocorito to Surutato, 1500 ft, 3 Mar 1971, *D.E. Breedlove 19111* (MO). **Mpio. San Ignacio:** ca. 2 km SSW of Vigas (Loma) and ca. 10 km WNW of Duranguito, 14 m, 26 Aug 2004, *M.C. Provance & J.S. Ross-Ibarra 9525* (UCR).

2b. Diospyros aequoris Standl. subsp. **balsensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov. (**Figs. 29, 30, 37j–m, 38c**). Type: MEXICO. Michoacan. Mpio. Tuzantla: km 68 carr. B. Juarez–Tuzantla, [19°14'N, 100°30'30"], 790 m, bosque tropical caducifolio, 16 Dec 2004. *I. Garcia R., M.C. Provance & J.A. Machuca 6863* (holotype: CIMI!; isotype: UCR!, and to be distributed).

Frutices vel arbores a *Diospyros aequori* ssp. *aequori* similis sed differt laminis foliorum plerumque latioribus, praesertim ad 1/4 et 3/4 longitudinem, lobis calycis fructiferi brevioribus, et fructibus epidermide infirme affixa.

Shrubs, sometimes arborescent, 1.5–3(–5) m tall; **trunk** smooth to somewhat roughened, bark forming large patches, varying from light to dark gray; **stems** glabrous when mature, but the young stems moderately

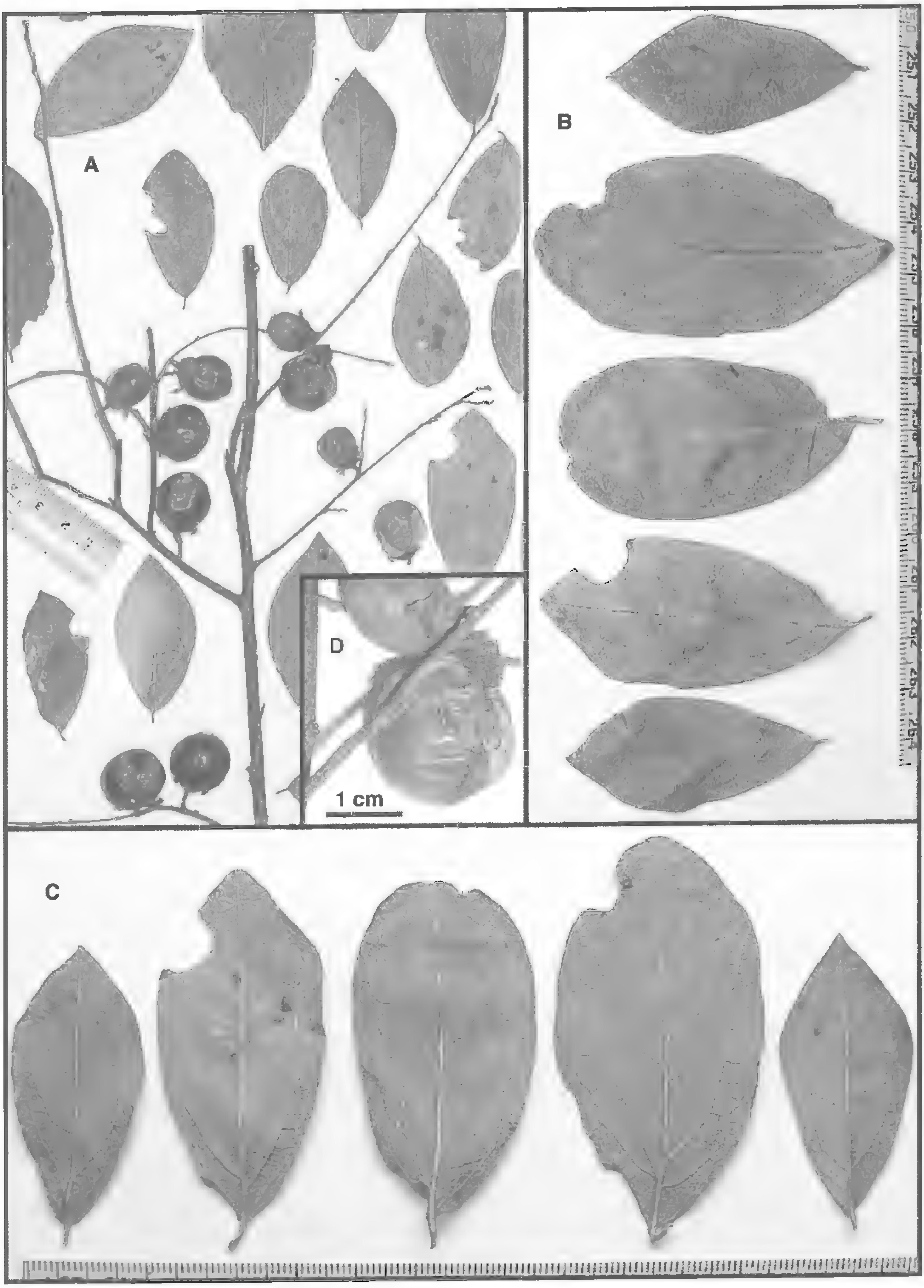

Fig. 29. The holotype of *D. aequoris* Standl. subsp. *balsensis* M.C. Provance, I. García & A.C. Sanders, subsp. nov. from km 68 carr. Benito Juarez–Tuzantla (*I. Garcia R. et al. 6863,* CIMI). A. Fruiting branchlet. B. Leaves (adaxial surface). C. Leaves (abaxial surface). D. Fruit detail.

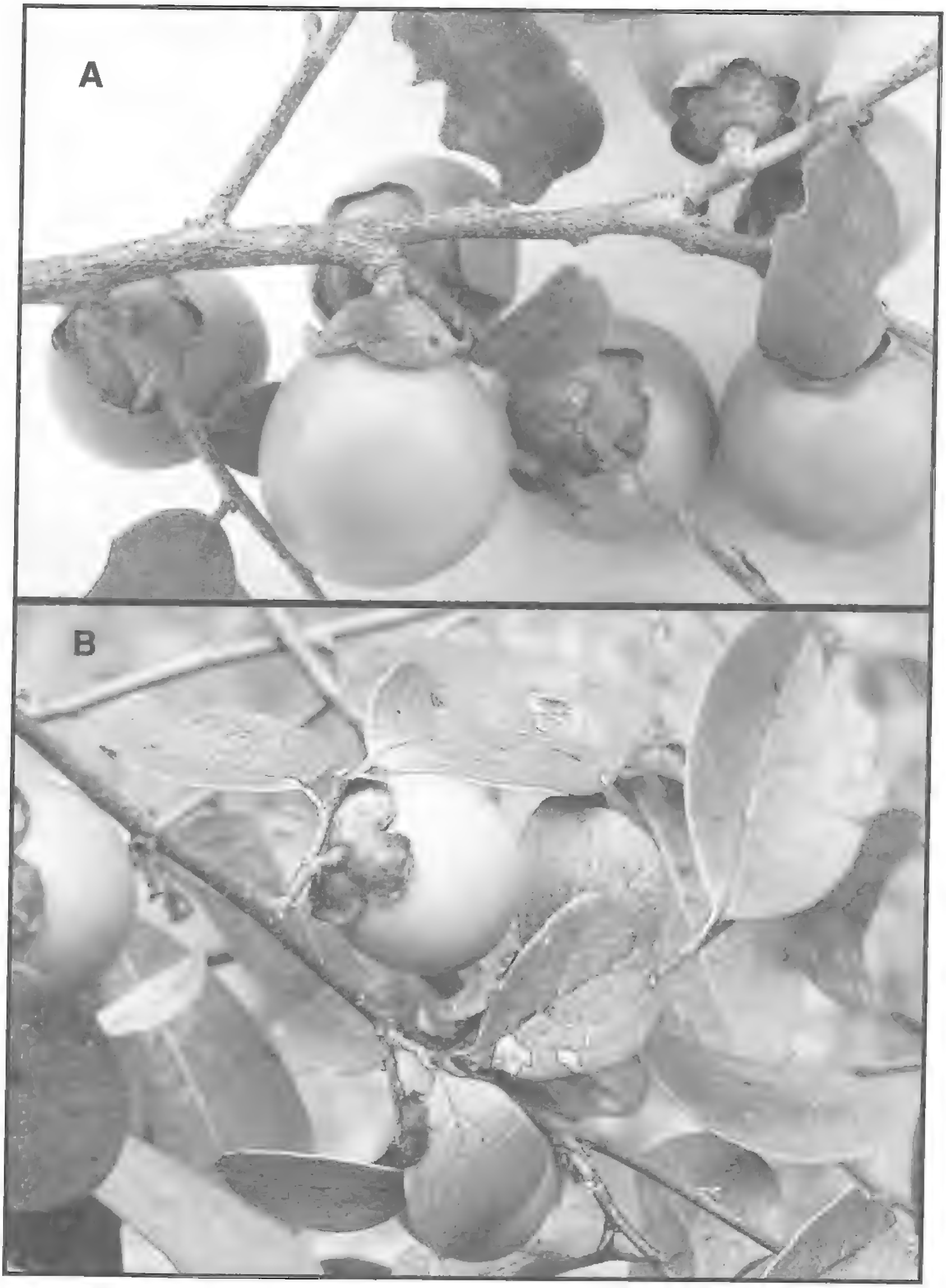

Fig. 30. *Diospyros aequoris* subsp. *balsensis* from km 68 carr. Benito Juarez–Tuzantla. A. Side view of the calyx and obovoid fruit. B. A fruit with slightly torn sinuses and subcoriaceous leaves with markedly impressed venation on the adaxial surface.

ascending hairy, the hairs wavy, sometimes twisting, clavate glandular hairs also present. **Petioles** 2–3(–5) mm long, cream to yellowish tomentulose, with sparse longer slightly wavy hairs, older leaves sometimes glabrate, the epidermis viscid, densely hairy above, the hairs straight to wavy, ascending to upright, cream to yellowish. **Lamina** subcoriaceous when mature, (30–)36–60(–72) mm long, 23–36(40) mm wide, the length to width ratio 1.5–2(–2.6) **:** 1, rhombic, elliptic or oval, *base* rounded, sometimes attenuate, *margin* slightly revolute, *apex* acutely to broadly rounded; **lower lamina surface** densely cream to yellow villous-velutinous, the hairs sometimes subappressed near the apex, becoming desiccated, pale and ashy, or covered with droplets of exudate, clavate glandular hairs often present, the stomatal apparatus opaque, white, and conspicuous; **upper lamina surface** wrinkled, the vestiture similar to but less dense than on the lower lamina surface, epidermis shiny, pale light green or gray to dark gray in herbarium material, sometimes crystal-papillose. **Venation** brochidodromous, the epidermis yellowish, prominent below, villous-velutinous, sparser above; **midrib** flush to slightly impressed above, impressed along the midrib-lamina seam; **lateral veins** (5–)7–9 per side, impressed above, or flush and impressed along the lamina-midrib seam; **3° veins** prominent below, impressed above; **4°–5° veins** slightly impressed above. **Male inflorescences** 2–3-flowered cymes; **peduncles** ± 2 mm long; **pedicels** 0.8–2 mm long, densely wavy-hairy, bracts linear-lanceolate, ± 1-2 mm long, conduplicate. **Male flowering calyx** narrowly campanulate to urceolate-campanulate, thinnish, cream, tawny or golden tomentulose outside, clavate glandular hairs often present, the epidermis golden brown, viscid, *tube* 2.8–3.2 mm long, glabrous inside, *lobes* acutely triangular, 3–3.3 mm long, 2.8–3.2 mm wide, glabrate inside, except for some scattered retrorse hairs and a narrow intramarginal band; **male corolla tube** 5.5–6.5 mm long, 3 mm wide, golden sericeous outside, with 3 shield-shaped glabrous basal regions, ± 2 mm long, bordered distally by minute wavy hairs; **male corolla lobes** obovate to rhombic, 2.0–2.5 mm long, 1.5 mm wide, margins sometimes involute. **Stamens** 12; **filaments** in two subgeminate tiers adnate to the corolla near the base, up to 2 mm long, reddish- brown; **anthers** lanceolate to narrowly lanceolate, up to 2.7 mm long. **Female inflorescences** densely pinkish-orange tomentulose. **Female flowering calyx** campanulate, narrowly winged, *tube* cupulate, 2–4 mm long, 3 mm wide, the basal 1/2–1/3 glabrous inside, upper 1/2–2/3 sericeous, the intramarginal band wide, pinkish-orange short wavy-hairy outside, with sparse straight ascending hairs, *lobes* thickish, acute, 5–5.5 mm long, 4–4.5 mm wide, vaguely acuminate to a blunt point; **female corolla tube** 6 mm long, 3.5 mm wide, pinkish-orange sericeous outside, with 3 small glabrous shield-shaped basal regions; **female corolla lobes** ovate, 2.5–3.5 mm long, 1.8–1.9 mm wide; **ovary** ovoid, 2.5 mm long, 2 mm wide, hirsutulous to stiffly ascending hairy, the hairs light blond; **styles** 3, fused basally, spreading; **stigmas** bifid to trifid, long, spreading; **staminodes** 5, narrowly lanceolate, up to 4.5 mm long, adnate to the base of the corolla, rarely inserted on the receptacle. **Fruiting pedicels** stout, 2–4(–6) mm long, sparsely to densely wavy-hairy, bracts 1–2, linear-lanceolate to ovate, 3–4 mm long, ± conduplicate. **Fruiting calyx** shallowly rotate to explanate, *tube* 4–6 mm long, hairy, *lobes* widely rounded, (3–)4–5.5 mm long, (8–)9–11 mm wide, apex sometimes cuspidate, reflexed. **Fruit** globose to obovoid, 1.5–2.5 cm in diameter, glabrous to sparsely ascending puberulent, epidermis tending to separate from the remainder of the fruit upon drying, dull yellow to golden brown, in living material greenish-yellow to yellow when mature, golden brown when fully ripe. **Seeds** 16–17 mm long, 9 mm radial depth, 5–7 mm wide.

This subspecies grows in dry tropical forest on slopes and mesas between 600 and 800 m in the Sierra Madre Occidental near the west end of the Sierra Madre del Sur in eastern Michoacan, western Guerrero, and the southwest part of the State of Mexico (Fig. 39). In this subspecies the epidermis of the fruit is weakly attached, a character useful in separating it from similar taxa. It is distinguished from D. *ae.* subsp. *martineziana* by thicker, wrinkled, frequently revolute lamina with a different shape. Lamina shape ratios (i.e., length **:** width, length **:** width at 1/4 length, length **:** width at 3/4 length) being significantly higher in *D. ae.* subsp. *balsensis*. In addition to differences in abaxial vestiture, the lamina of *D. ae.* subsp. *chutlensis* is thinner, less wrinkled, and has an undulate margin. The venation in *D. ae.* subsp. *balsensis* is more prominent than in *D. ae.* subsp. *chutlensis*. This subspecies is similar to *D. ae.* subsp. *aequoris*, but has shorter fruiting calyx lobes, and the lamina is usually wider.

Specimens examined: **MÉXICO. Guerrero. Mpio. Ajuchitlán del Progreso:** Cuahuilote, 29 Jan 1934, *G.B. Hinton et al. 5568* (DES, K). **Mpio. Coyuca de Catalán:** Paso de Arena, 5 Jun 1934, *G.B. Hinton et al.* 6117 (NA, K). **Mpio. Zirándaro de los Chávez:** A 14 km al SW del Tálamo, 710 m, 6 Sep 1982, *J.C. Soto N. & G. Silva R. 4364* (XAL). **México. Mpio. Temascaltepec:** Bejucos, 610 m, 22 May 1933, *G.B. Hinton 3959* (K); same location, 28 Nov 1934, *G.B. Hinton 7058* (K, ARIZ, NA, US, MO). **Michoacan. Mpio. Arteaga:** Puente San Salvador, 630 m, 14 Mar 2005, *Provance 9919* (UCR, CIMI). **Mpio. Huetamo:** Arroyo Seco, *I. Garcia R. et al. 6873* (CIMI, UCR); Eréndira, 800 m, 5 Nov 1977, *J. Rzedowski 35495* (AAU, IEB). **Mpio. Tuzantla:** ca. km 68 carr. Zitácuaro-Tuzantla, 789 m, 16 Dec 2004, *I. Garcia R. et al. 6867* (CIMI, UCR); 9 km al NE de Tuzantla, 750 m, 20 Jun 1983, *J.C. Soto N. 5325* (MO); 10 km al NE de Tuzantla, 700 m, 12 Dec 1971, *F. Chiang et al. 547* (WIS, NA, SD, XAL).

2c. Diospyros aequoris Humb. & Bonpl. ex Willd. subsp. **chutlensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov. (**Figs. 31, 32, 33, 39a, c**). Type. MÉXICO. Guerrero. Mpio. La Unión: Paraje "El Palomar," trayecto de terracería a Chutla, 10 m, 4 Dec 1993, *E. Guízar N. & L. Pimentel B. 3067* (holotype: IEB!; isotype: CHAPA).

Arbores et frutices multicaules a *Diospyros aequori* ssp. *aequori* similis sed differt foliis laminis tenuioribus, marginibus undulatis, venatione abaxiali subtiliore, et venatione secondaria in arcibus languidis terminanti.

Trees and multi-stemmed shrubs, 1.5–7.6 m tall; **trunk** somewhat smooth to fissured and scaly, the scales very thick, irregular, whitish-gray to grayish-beige; **branches** smooth to scaly or irregularly roughened; **stems** glabrous, or with some persisting wavy hairs in the second year, grayish-beige in life, the young stems densely short wavy-hairy, with sparse amounts ascending straight hairs up to 2 mm long near the shoot apex, the epidermis viscid, light dull orange to reddish-brown. **Petioles** 2–5 mm long, rugose, *margin* not or barely winged, dull orangish-red to gray magenta or light purplish-brown, rarely yellowish, densely hairy below, the hairs wavy or curved distally to wavy, off-white to tawny, densely hairy off-white to tawny wavy-hairy on the upper surface. **Lamina** flat or sometimes wavy in older leaves, but not typically wrinkled, chartaceous, 43–72 mm long, 18–34 mm wide, length to width ratio 1.5–2.5 : 1, elliptic to oblong-obovate, young leaves sometimes orbicular, the epidermis pale light green in life, *base* rounded to barely decurrent on the petiole, *margin* undulate, at least in life, sometimes slightly revolute, *apex* obtusely rounded; **lower lamina surface** glabrate to densely hairy, the hairs wavy or curved distally, < 1 mm long, upright, off-white to tawny, with sparse subappressed straight hairs ≤ 2 mm long, clavate glandular hairs often present, deciduous, leaving the brownish epidermis viscid, the stomatal apparatus subopaque, conspicuous; **upper lamina surface** with dense, tawny, wavy hairs, and occasional stellate hairs, the epidermis dark greenish-brown. **Venation** ± arcolanguid (the major lateral veins fading terminally, forming indistinct loops with superadjacent lateral veins); **midrib** prominent below, with more long straight hairs than the lamina surface, impressed basally on the upper surface, sparsely upright wavy-hairy, clavate glandular hairs often present, the epidermis dull yellow to light magenta; **lateral veins** 5–8 per side, irregularly spaced, angles of divergence from the midrib irregular, fine but prominent below, pubescent, the epidermis light dull orange to purplish-brown, barely raised above, the lamina-vein seams impressed; **3° veins** slightly raised below, inconspicuous above. **Male inflorescences and flowers** unknown. **Female inflorescences** unknown. **Female flowering calyx** (based on one immature fruiting calyx) densely tomentulose outside, *tube* thick, 2.3 mm long, ± 3 mm wide, *lobes* 7 mm long, 8 mm wide; **female corolla tube** 4 mm long, 3.5 mm wide, light reddish-cream sericeous inside, the hairs sparser in the basal 1/3, the epidermis dark reddish-brown; **female corolla lobes** ovate, 3 mm long, 1.8 mm wide; **Pistil** unknown. **Fruiting pedicels** 2.5–5 mm long, densely curly to wavy-hairy, bracts opposite, lanceolate, ± 2 mm long, concave. **Fruiting calyx** cupulate to explanate, outside minutely hairy, the hairs kinked to wavy, the epidermis shiny and viscid, dark reddish-brown, *tube* 3.5–6 mm long, dehiscent below the sinus for a short distance, the upper 1/2 becoming sparsely sericeous inside, glabrous basally, *lobes* obtuse, 4–7 mm long, 6.5–12 mm wide, vaguely pointed, laxly reflexed, tawny to reddish-brown sericeous inside with a broad intramarginal band. **Fruit** 2–2.3 cm in diameter, golden brown, sparsely pubescent, the hairs up to 2 mm long, translucent to tawny. **Seeds** 11–13 mm long, 6–6.5 mm radial depth, 4.5–5 mm wide.

The subspecies is endemic to the coastal plains of western Guerrero (Fig. 40). It typically grows on loamy or silty sand at the base of eroding slopes and on roadside embankments in dry tropical forest, and along the edges of planted fields. Known localities do not seem to be protected, but there are collections

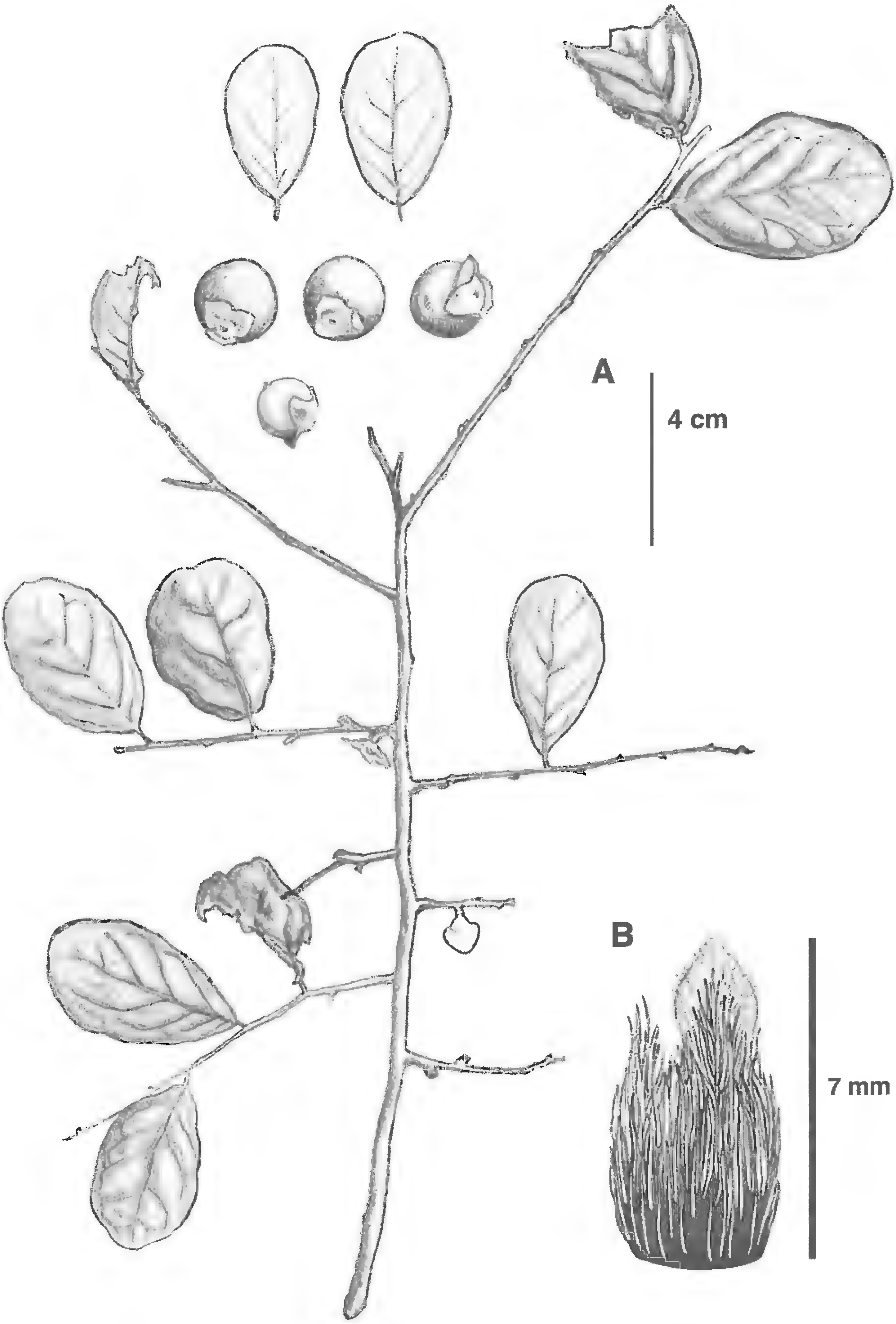

Fig. 31. **A.** *Diospyros aequoris* Standl. subsp. *chutlensis* M.C. Provance, I. García & A.C. Sanders, subsp. nov., based on the holotype from Paraje "El Palomar," trayecto de terracería a Chutla, Guerrero, Mexico (*E. Guízar N. & L. Pimentel B. 3067*, IEB). **B.** Female corolla of subsp. *chutlensis,* based on *G.B. Hinton et al. 14583* from Atoyac, Guerrero.

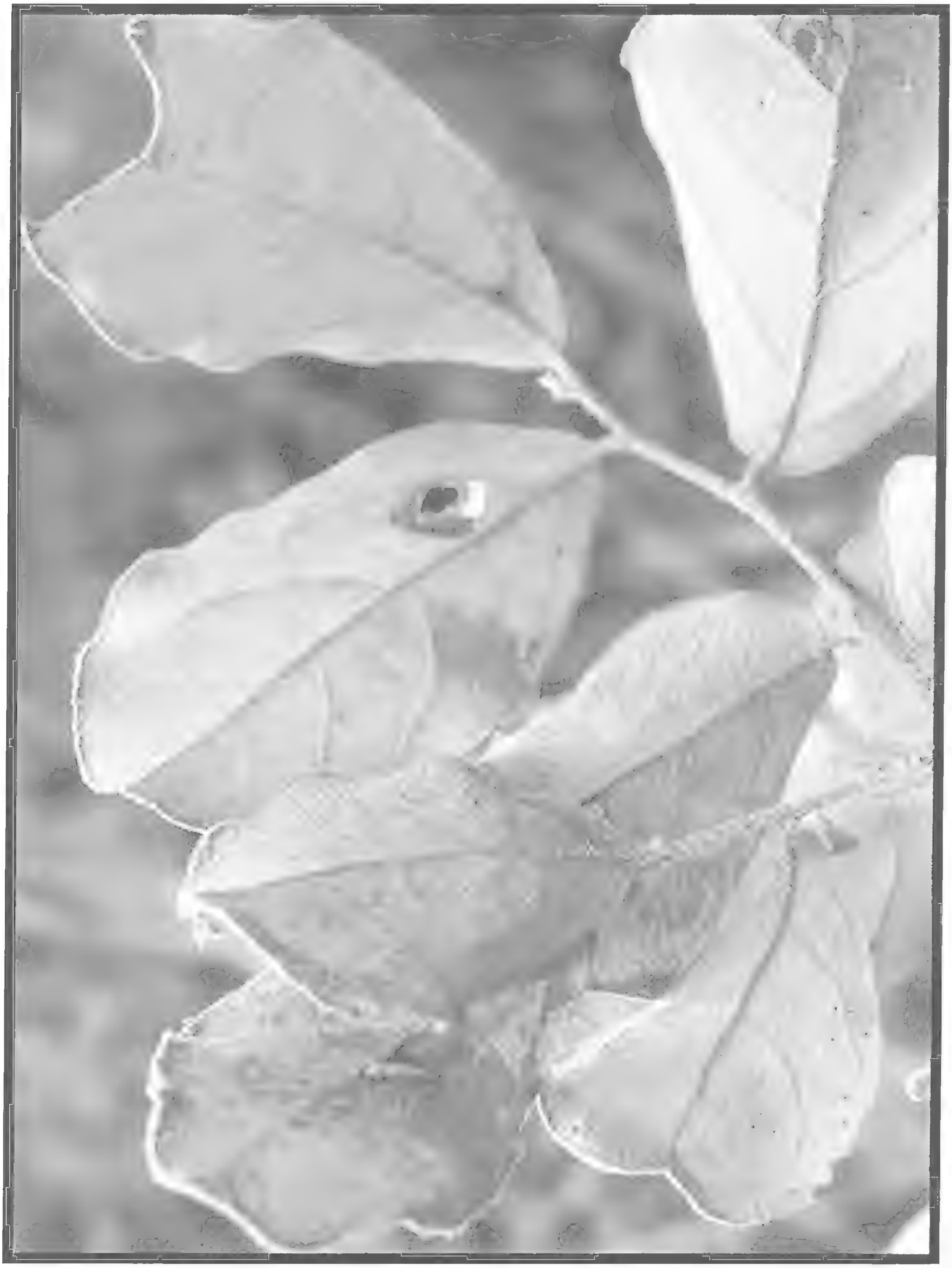

Fig. 32. Leaves of *D. aequoris* subsp. *chutlensis* from along dirt road between Hwy 200 and Chutla de Nava, Guerrero, with undulant margins.

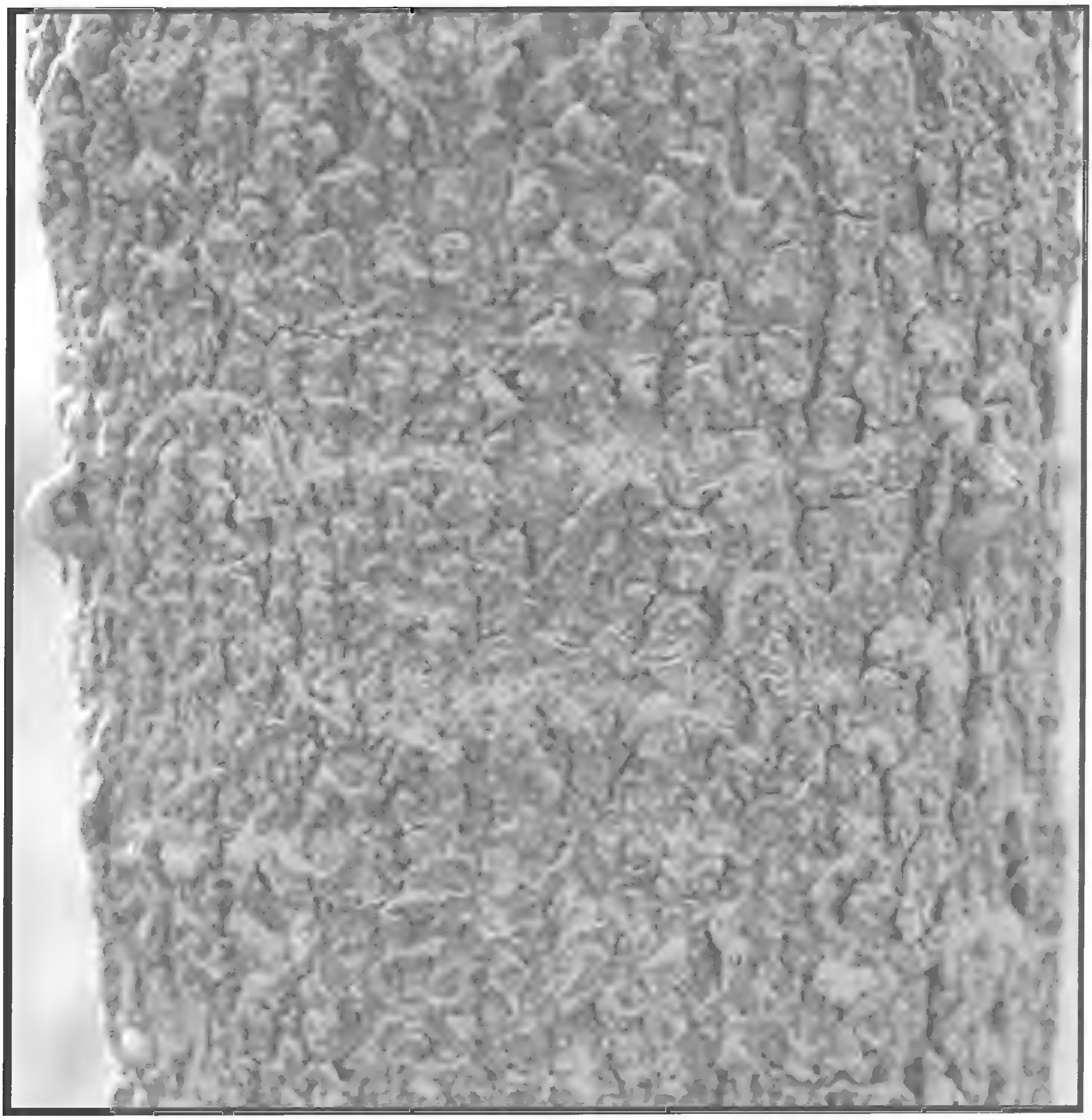

Fig. 33. Trunk (c. 9 cm dia.) of *D. aequoris* subsp. *chutlensis* from along dirt road between Hwy 200 and Chutla de Nava, Guerrero.

from Barbulillas, several hundred yards away from an ecological reserve in the vicinity of Ixtapa. Fonseca and Lozada-Pérez's (1993) description of "*Diospyros acapulcensis*" as one of the four most common shrubs in the halophytic vegetation zone along the coast southwest of Laguna de Coyuca may be in reference to this taxon. Although we have not seen specimens from their studies, based on the habitat and elevation, we suspect these reports represent *D. ae.* subsp. *chutlensis* or *D. salicifolia*. However, *Koch & Fryxell 82139* (US!, CHAPA!), collected near this locality represents *D. ae.* subsp. *chutlensis*. *Diospyros ae.* subsp. *martineziana* is separated by its smaller petioles, smaller lamina shape ratios, soft, fine, light colored, glossy abaxial lamina hairs, and brochidodromous venation. This taxon is quantitatively distinguished from *Diospyros salicifolia* by its shorter leaves with smaller lamina shape ratios (Table 1. characters 3, 7, 8). This subspecies is known to occur near, but not at Acapulco.

Table 1. Twenty-three leaf and fruiting inflorescence characters used in statistical analyses.

	Character	Abbrev.	Type
1.	lamina length	LL	leaf size
2.	lamina width	LW	leaf size
3.	lamina length : lamina width	LL:LW	leaf shape
4.	petiole length	ptL	leaf size
5.	lamina width at 0.25 length	LW1/4	leaf size
6.	lamina width at 0.75 length	LW3/4	leaf size
7.	lamina length : width at 0.25 length	LL:LW1/4	leaf shape
8.	lamina length : width at 0.75 length	LL:LW3/4	leaf shape
9.	lamina length : distance between four centermost lateral veins	LL:V	venation pattern
10.	lamina width at 0.25 length : width at 0.75	LW1/4:LW3/4	leaf shape
11.	lamina width at 0.25 : lamina width	LW1/4:LW	leaf shape
12.	lamina width at 0.75 : lamina width	LW3/4:LW	leaf shape
13.	fruiting pedicel length	pdL	infl. size
14.	fruiting sepal width	SW	infl. size
15.	fruiting sepal length	SL	infl. size
16.	fruiting calyx tube length	CL	infl. size
17.	fruiting sepal width : fruiting sepal length	SW:SL	infl. shape
18.	fruiting sepal width : fruiting calyx tube length	SW: CL	infl. shape
19.	fruiting sepal width : fruiting pedicel length	SW:pdL	infl. shape
20.	fruiting sepal length : fruiting calyx tube length	SL: CL	infl. shape
21.	fruiting sepal length : fruiting pedicel length	SL:pdL	infl. shape
22.	fruiting calyx tube length : fruiting pedicel length	CL:pdL	infl. shape
23.	fruiting calyx size (fruiting calyx tube length + fruiting sepal width + fruiting sepal width)	CX	infl. size

Representative specimens. **MEXICO. Guerrero. Mpio. Acapulco de Juarez:** km 5.5 carr. Acapulco–Pie de la Cuesta, 60–160 m, 21 Oct 1982, *S.D. Koch & P.A. Fryxell 82139* (US, CHAPA); Punta Gorda, Laguna de Tres Palos, 10 m, 11 Oct 1988, *N. Diego 4920* (IEB). **Mpio. Átoyac de Alvarez:** Atoyac, [17°12'N, 100°26' W], 25-300 m, 30 Aug 1939, *G.B. Hinton et al. 14583* (UC, IJ, K). **Mpio. Coyuca de Benítez:** between Acapulco and Ixtapa, just N of El Zapote, 16 Jan 1983, *J.S. Miller et al. 461* (MO). **Mpio. José Azueta:** Punta Ixtapa, al W de Ixtapa Zihuatanejo, 30 m, 2 Apr 1991, *G. Castillo C. & P. Zamora C. 6276* (XAL); Ixtapa, Col. Barbulillas, 0.5 km N of Hotel La Costa, 25 m, 10 Mar 2005, *Provance 10020A* (UCR, CIMI) and *Provance 10020B* (UCR, CIMI). **Mpio. La Unión de Isidoro Montes de Oca:** Felicianos, road N from Hwy 200, 45 m, *Provance 9981* (UCR, CIMI); road N from Hwy 200 going towards Chutla, 61 m, *Provance 9923* (UCR, CIMI); Joluta, several km N of Hwy 200, 61 m, *Provance 9930* (UCR, CIMI); vicinity of Coyuquila and La Salada, along Hwy 200, 25 m, *Provance 9933* (UCR, CIMI); Japoncito, dirt road on N side of Hwy 200, 26 m, *Provance 9932* (UCR, CIMI); 46 mi NW of Zihuatanejo, 7 Mar 1979, *C.D. Johnson 667-79* (MO).

2d. Diospyros aequoris Standl. subsp. **martineziana** (Standl. ex Leavenworth) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov. (**Figs. 34, 38d**). Basionym: *Diospyros martineziana* Standl. ex Leavenworth, Amer. Midl. Naturalist 36:184. 1946. Type: MEXICO. Michoacan: Tancitaro Region, Acahuato, above 2500 ft, 20 Aug 1941, *W.C. Leavenworth & H. Hoogstraal 1735* (holotype: F).

Trees, sometimes shrubs, 1.2–8 m tall; **trunk** up to 30 cm in diameter, bark somewhat smooth (not slick), with scattered checked regions, sometimes irregularly patchy, light to dark gray; **stems** scurfy to glabrous and very dark or castaneous, the young stems densely hairy, the hairs slightly wavy to curly, spreading to ascending, colorless to white, clavate glandular hairs sometimes present. **Petioles** 2–3(–5) mm long, glabrous to densely straight to slightly wavy subappressed hairy, pubescent above. **Lamina** chartaceous, orbicular, oblong or obovate, 19–61(–65) mm long, 13–40 mm wide, sapling leaves 70–87 mm long, 40–54 mm wide, length to width ratio 1.2–1.5 : 1, *base* rounded to subcordate, slightly decurrent on the petiole, *margin* flat, *apex* rounded to obtuse, sometimes retuse, sometimes subacute; **lower lamina surface** moderately to densely hairy, the hairs wavy to straight, subappressed to upright, soft, fine, glossy, white to gold, clavate glandular hairs sometimes present, the epidermis, yellowish to dark green; **upper lamina surface** sparsely

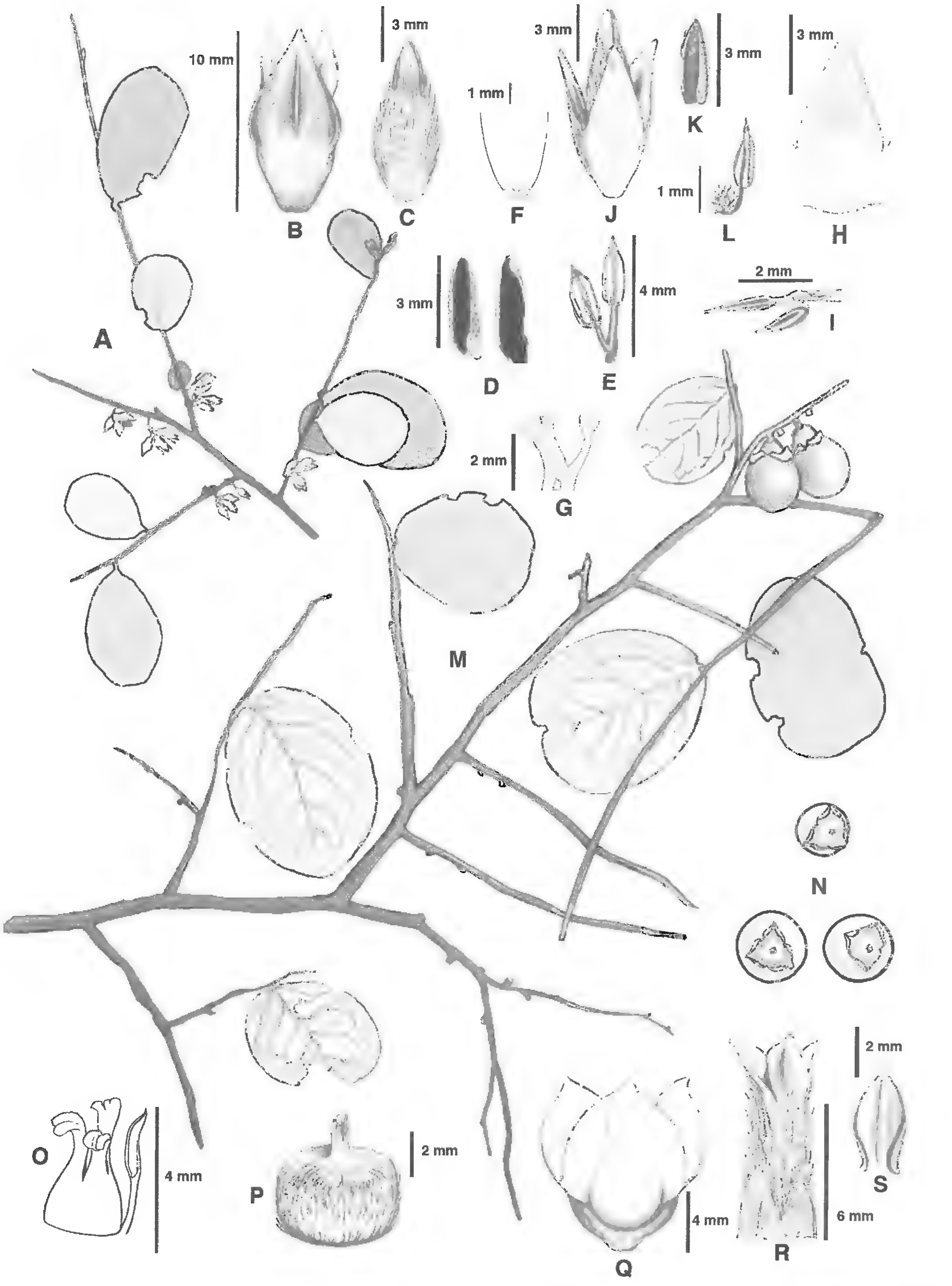

Fig. 34. *Diospyros aequoris* subsp. *martineziana*. **A–E.** Based on *M.C. Provance & I. García R. 9393* (UCR). **A.** Stem with young growth and male flowers. **B.** Male flower with keeled calyx lobe. **C.** Male corolla. **D.** Male corolla lobes. **E.** Geminate stamens. **F–I.** Based on *M.C. Provance & I. García R. 9394* (UCR). **F.** Male corolla glabrous zone. **G.** Lateral fusion of filaments. **H.** Adaxial surface of male flowering calyx. **I.** Geminate stamens. **J–L.** Based on *J.C. Soto N. & E.M. Martínez 4189*. **J.** Male corolla. **K.** Male corolla lobe. **L.** Pistillode and stamen with filament inserted on the receptacle. **M–N.** Based on *I. García R. & C. Conrado 6989* (UCR). **M.** Fruiting branchlet. **N.** Fruiting calices. **O.** Pistil and staminode (vestiture not illustrated) of flower type I, based on *M.C. Provance & I. García R. 9396A* (UCR). **P–S.** Based on *M.C. Provance & I. García R. 9392* (UCR). **P.** Pistil of flower type II. **Q.** Female flower. **R.** Female corolla. **S.** Female corolla lobe.

to densely hairy, the hairs uniformly curved to wavy, ascending to upright, soft, fine, white to gold, the epidermis olive to dark green, hair bases raised and nearby epidermal cells enlarged. **Venation** brochidodromous, yellow to chartreuse; **midrib** prominent below, narrow, with spreading, straight to slightly wavy hairs above; **lateral veins** (3–)4–6(–7) per side, fine but prominent below, connecting with superadjacent laterals inward from the margin, sparsely hairy, barely impressed to barely raised above (± obscure); **3° veins** very fine below, obscure above. **Male inflorescences** solitary (1–)3–4(–6)-flowered cymes, densely cream to yellowish-orange tomentulose to wavy-hairy; **peduncles** 0.5–3 mm long; **pedicels** 0.5–2 mm long. **Male flowering calyx** sometimes slightly winged, moderately to densely white to yellowish velutinous-pubescent, the hairs sometimes subappressed with tomentulose undercoat, epidermis viscid *tube* 2.5–3.5 mm long, 3.8–4 mm wide, glabrous inside, *lobes* acute, (3.5–)5.5–6(–7) mm long, (3–)4–4.5(–5.5) mm wide, sometimes keeled, the nerves sometimes obvious, densely hairy inside, the intramarginal band width variable; **male corolla tube** 4.5–6 mm long, 3–4 mm wide, sericeous outside, with 3 pale pink 0.5–0.8 mm long shield-shaped glabrous basal regions; **male corolla lobes** lance-ovate to elliptic, 3–3.5 mm long, 1.2–2.5 mm wide. **Stamens** 10–12; **filaments** adnate to the base of the corolla or inserted on the receptacle, 2–2.5 mm long, narrowed distally, free, geminate or joined laterally, rarely in threes; **anthers** lance-ovate, 2–2.5 mm long, sometimes rostrate. **Female inflorescence** densely hairy, bracts narrowly triangular, 1.0–1.3 mm long. **Female flowers** apparently dimorphic (types I and II below, both types can be found in one individual); **female flowering calyx** densely tomentulose outside, with some longer, straight to slightly wavy, ± ascending, light gold hairs, *tube* half-globose, 5–6 mm long, 7 mm wide, the upper 1/2 densely hairy inside, lower 1/2 glabrate with a few reddish glandular hairs, *lobes* 7–8 mm long, 7–8 mm wide, acuminate, the nerves prominent, densely hairy inside with a broad intramarginal band; **female corolla tube** 6 mm long, 3.3 mm wide, with 3 shield-shaped 3.5 mm long glabrous basal regions: **flower type I corolla tube** basal regions pinkish, ± overlapping; **flower type II corolla tube** basal regions dark red, not or barely overlapping; **female corolla lobes** rhombic to ovate, 4 mm long, 2 mm wide; **flower type I ovary** ovoid, minutely cream sericeous; **flower type II ovary** shaped like a barrel, glabrous to scantily hairy, epidermis golden; **flower type I styles** 3, free, arching outward; **flower type II styles** 3, in a fused column; **stigmas** bifid. **Fruiting pedicels** 2–4 mm long, bracts slender, 1.8–2 mm long, about 0.3 mm wide, conduplicate. **Fruiting calyx** shallowly rotate to cupuliform, tomentulose to wavy-hairy outside, much of the vestiture including the longer hairs, deciduous in age, sometimes persisting on the conspicuously viscid, epidermis *tube* 5–5.5 mm long, densely hairy inside, *lobes* spreading, obtuse to rounded, 3–8 mm long, 8.5–10.5 mm wide, the margins usually revolute. **Fruit** globose, subglobose or obovoid, 2–2.3 cm in diameter, glabrous or sparsely hairy, the hairs straight to slightly wavy, fine, ascending, white to golden, clavate glandular hairs sometimes present, epidermis glaucous, pruinose, scintillant, tending to separate from the remainder of the fruit upon drying, light grayish-yellow to golden brown, mature fruit light green in life. **Seeds** 13–14 mm long, 6 mm radial depth, 5.5 mm wide.

This subspecies grows in dry deciduous forest of the Apatzingan Valley, Michoacan, between 320 and 700 m (Fig. 40). Its occurrence has not been documented for any protected area. It is an occasional tree at the type locality on the slopes of Acahuato, north of Apatzingan, Michoacan, where it is sometimes spared adjacent to milpas to produce shade for workers (pers. obs).

Representative specimens: **MÉXICO. Michoacan: Mpio. Apatzingan:** Acahuato, 671 m, 2 Jul 2004, *M.C. Provance & I. Garcia R. 9392, 9393, 9395, 9396A, 9396B, 9394* (CIMI, UCR); Acahuato, 750 m, 17 Feb 2005, *I. Garcia R. & C. Conrado 6989, 6983* (CIMI, UCR); above Apatzingan, 2000 ft, 13 Aug 1941, *W.C. Leavenworth & H. Hoogstraal 1502* (MO, ILL), same location, *1490* (MO, ILL), same location, *1494* (MO, ILL); Mt. Apatzingan, 2000 ft, 20 Aug 1941, *W.C. Leavenworth & H. Hoogstraal 1728* (MO). **Mpio. Huetamo:** En Pataseo [Patasco], 6 km al E de Quetzería, 300 m, 18 Jul 1982, *J.C. Soto N. & E.M. Martínez 4189* (XAL, CHAPA, MO, ILL). **Mpio. La Huacana:** Sierra Las Cruces, ca. 6.5 km (by air) west-southwest of Los Ranchos, 600 m, 6 Dec 2003, *Steinmann 3911* (UCR). **Mpio Parácuaro:** "Paso de Yeguas" [Crucero de las Yeguas], 17 km a W de Cuatro Caminos, 250 m [± 320 m], 18 Oct 1982, *R. Torres C. 1541* (CAS).

2e. Diospyros aequoris Standl. subsp. **rekoi** (Standl.) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov. (**Figs. 35, 38a**). Basionym: *Maba rekoi* Standl. Contr. U.S Natl. Herb. 20:193. 1919. Type: MEXICO. Oaxaca. [Mpio.

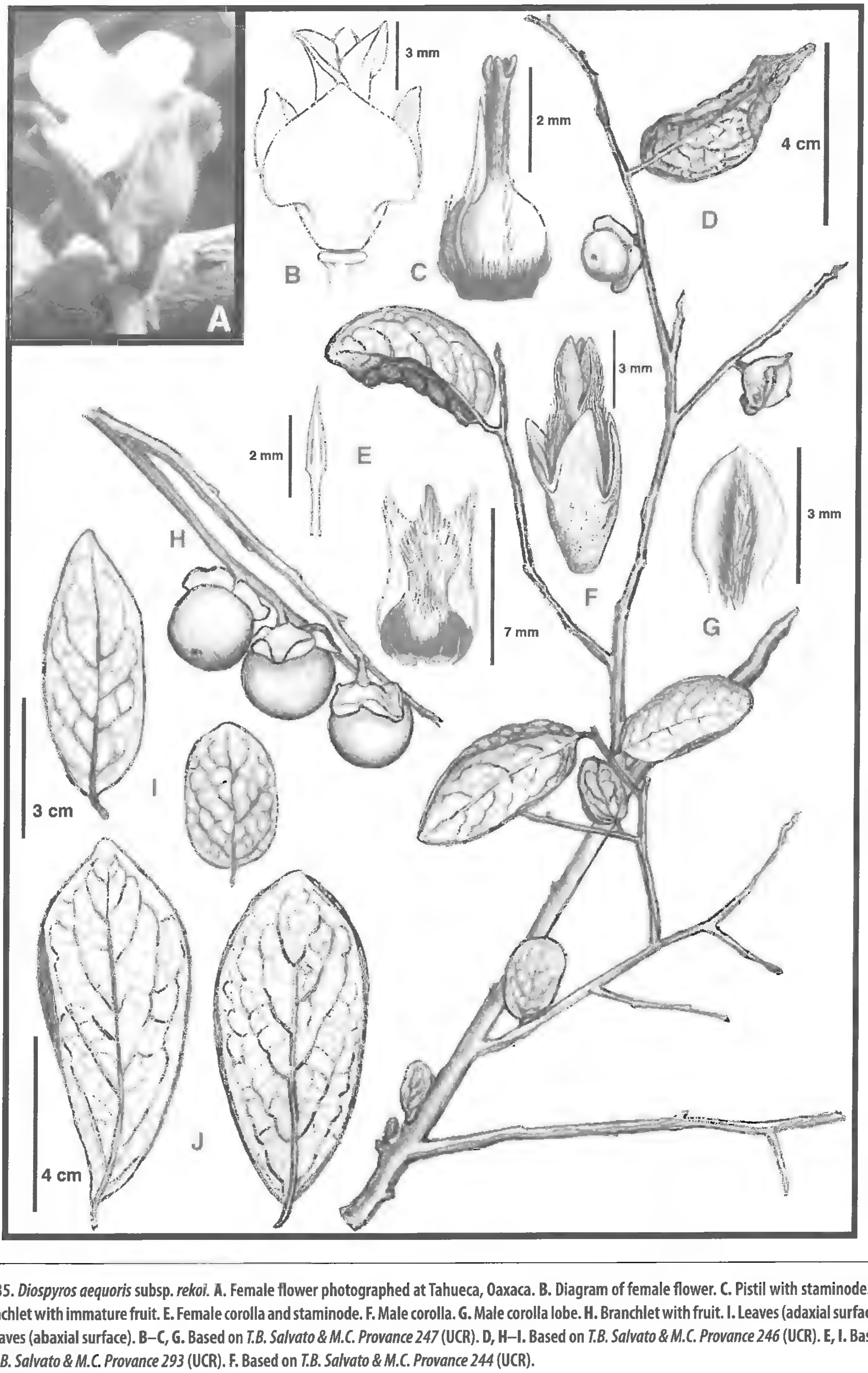

Fig. 35. *Diospyros aequoris* subsp. *rekoi.* **A.** Female flower photographed at Tahueca, Oaxaca. **B.** Diagram of female flower. **C.** Pistil with staminode. **D.** Branchlet with immature fruit. **E.** Female corolla and staminode. **F.** Male corolla. **G.** Male corolla lobe. **H.** Branchlet with fruit. **I.** Leaves (adaxial surface). **J.** Leaves (abaxial surface). **B–C, G.** Based on *T.B. Salvato & M.C. Provance 247* (UCR). **D, H–I.** Based on *T.B. Salvato & M.C. Provance 246* (UCR). **E, I.** Based on *T.B. Salvato & M.C. Provance 293* (UCR). **F.** Based on *T.B. Salvato & M.C. Provance 244* (UCR).

San Pedro Pochutla]: Puerto Angel, [15°40'N, 96°29'W, 1 m], 28 Sep 1917, *B.P. Reko 3429* (HT: US-842523). *Diospyros portus* Standl. Publ. Carnegie Inst. Wash. 461(4):80. 1935.

Not *Diospyros rekoi* Standl., J. Wash. Acad. Sci.17: 527. 1927.

Shrubs, rarely trees, 1–4(–12) m tall, sometimes with multiple stems from root and crown sprouts; **trunk** somewhat smooth (not slick) to checked, the bark whitish with gray to gold patches; **stems** glabrous, sometimes hispidulous or with longer desiccated hairs in the 2nd year, young stems densely puberulent, with some additional longer, spreading to ascending hairs. **Petioles** (3–)4–6(–7) mm long, glistening, dark, reddish, densely minutely wavy-hairy on the lower surface, the hairs sparser and longer above. **Lamina** subcoriaceous, oblong or elliptic to obovate, (40–)50–90(–100) mm long, 16–35(–45) mm wide, the length to width ratio 2.2–2.8 **:** 1, *base* broadly rounded to the petiole, *margin* revolute, *apex* broadly to obtusely rounded (revolute lamina margins sometimes forming a false point); **lower lamina surface** moderately velutinous to wavy-velutinous, the hairs ascending to upright, clavate glandular hairs often present, deciduous, leaving the epidermis conspicuously viscid, the stomatal apparatus opaque and conspicuous to translucent; **upper lamina surface** wrinkled when mature, velutinous to wavy-velutinous. **Venation** brochidodromous; **midrib** prominent below, ascending velutinous, impressed above, velutinous to wavy-velutinous, clavate glandular hairs often present; **lateral veins** 4–8 per side, prominent below, impressed above; 3° veins prominent below, impressed above; 4° veins sometimes darkened below. **Male inflorescences** 1–3-flowered cymes, hirsutulous; **peduncles** 1–3 mm long; **pedicels** 0.3–2 mm long, bracts linear-lanceolate, 2–3 mm long, conduplicate. **Male flowering calyx** densely puberulent, the epidermis viscid, *tube* 3–4 mm long, 3–3.5 mm wide, glabrate inside, some scattered minute hairs in the lower 1/2, *lobes* acute, (3.5–)5–6 mm long, 3–5 mm wide, glabrous to sparsely puberulent inside, the intramarginal band somewhat narrow; **male corolla tube** 4.8–5.5 mm long, 3 mm wide, mostly sericeous outside, but basal 0.3–0.8 mm glabrous; **male corolla lobes** oblong, ovate or rhombic, 3–4 mm long, 2 mm wide; **Stamens** (11–)12; **filaments** adnate to the tube near the base, irregularly or vaguely in two tiers, or inserted on the receptacle, 2 mm long, sometimes subgeminate; **anthers** lanceolate to oblong, 2–2.4 mm long, sometimes minutely lobed basally on each side of the connective ('eared'), sometimes apiculate. **Female inflorescences** wavy-hirsutulous with orangish ascending hairs, bracts linear-lanceolate, 2–3 mm long, conduplicate. **Female flowering calyx** campanulate, straight to wavy-hairy, the hairs upright to ascending, orangish, *tube* cupulate, 2.5–3 mm long, 5 mm wide, *lobes* obtusely rounded, 5.5–6 mm long, 6.5 mm wide, barely acuminate; **female corolla tube** 5.5–7.5 mm long, 3.5–4 mm wide, exterior sericeous nearly to the base; **female corolla lobes** ovate to rhombic, 3.3-4 mm long, 2.5 mm wide; **ovary** globose to somewhat conical, ± 2 mm in diameter, usually glabrous, sometimes with 3 rows of long hairs running from the base of the ovary to the base of the style column; **styles** 3, column ± 2.5 mm long; **stigmas** bifid, ± 0.5 mm long, somewhat spreading; **staminodes** 3(–5), opposite to the petals, flat, the sterile anther narrowly lanceolate, 2 mm long, the filament 2 mm long, adnate to the base of the corolla for 0.5–0.8 mm. **Fruiting pedicels** 4–8(–12) mm long, often glabrate. **Fruiting calyx** rotate, glabrate to sparsely straight to wavy-hairy, the epidermis dark brown and conspicuously viscid, *tube* 4.5–6.5 mm long, hairy inside to the base, *lobes* 5–8 mm long, 11–14 mm wide, sericeous inside with a broad intramarginal band. **Fruit** 1.5–2.2 mm in diameter, epidermis reportedly yellow when mature. **Seeds** unknown.

This subspecies is endemic to the coastal region of Oaxaca (Fig. 40). It is common on sandy mesas with littoral scrub near the beach, and on rocky seaside cliffs where it tolerates at least small amounts of salt-spray. It also occurs a few kilometers inland on steep rocky slopes with dry tropical forest. Saplings are sometimes very common along disturbed sandy roads near the beach. This subspecies forms intermediates with *D. ae.* subsp. *tehuantepecensis* several kilometers east of Bahias de Huatulco, but can generally be distinguished from it by its longer and wider lamina, longer petioles, larger calyx including wider fruiting sepals, longer fruiting pedicels, and longer tube.

Representative specimens: **MEXICO. OAXACA. Mpio. San Pedro Mixtepec:** Puerto Escondido, 22 Sep 1982, *R. Cedillo T. & R. Torres C. 1813* (MO, XAL). **Mpio. San Pedro Pochutla:** Tahueca, 10–15 m, 3 Aug 2003, *T.B. Salvato & M.C. Provance 244, 245, 246, 247* (UCR).

Mpio. Santa María Huatulco: Cerro San Antonio, Bahia de San Agustin, 50–60 ft, *T.B. Salvato & M.C. Provance 293* (UCR). **Mpio. Santa María Tonameca:** Playa Agua Blanca, 35 m, 4 Aug 2003, *T.B. Salvato & M.C. Provance 363, 366* (UCR).

2f. Diospyros aequoris Standl. subsp. **tehuantepecensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov. (**Figs. 36, 37a–i, 39b**). Type: MEXICO. Oaxaca. Mpio. Tehuantepec: Mixtequilla, senda a las ruinas del Cerro Guiengola, 16°22'55.4"W, 95°18'27.3"W, 300 m, 6 Aug 1994, *J.L. Panero & J.I. Calzada 4490* (holotype: IEB-48849!; isotypes CAS!, TEX!).

Arbores et frutices a *Diospyros aequori* ssp. *aequori* similis sed differt laminis foliorum griseoribus plerumque angustioribus ad 1/4 et 3/4 longitudinem, infra venatione cremea vel magentea vel coloribus ambabus maculata.

Trees or shrubs, 2–5 m tall; **trunk** unknown; **stems** glabrous to pulverulent or scurfy, the young stems pilosulose to villosulous, with some longer slightly wavy ascending reddish-orange hairs near the shoot apex. **Petioles** 2–4(–5) mm long, hairs similar to young stems, rugose below and sometimes above, epidermis magenta to yellowish or cream, sometimes variously striated. **Lamina** chartaceous to subcoriaceous, elliptic or oblong, sometimes obovate, rarely oblanceolate, 29–56(–67) mm long, 12–24(–27) mm wide, length to width ratio (1.6–)2.1–2.6 **:** 1, *base* rounded to the petiole, *margin* sometimes revolute near the base, *apex* obtusely rounded, sometimes acutely; **lower lamina surface** hairs moderate to dense, straight to wavy, ascending to subappressed, clavate glandular hairs often present, the epidermis usually light gray, the stomatal apparatus opaque, white, and conspicuous; **upper lamina surface** usually wrinkled, villous, clavate glandular hairs often present, the epidermis densely papillose. **Venation** brochidodromous to arcolanguid, below off-white to gray pilosulose to villosulous, the epidermis cream to magenta or speckled with both colors; **midrib** prominent below, impressed above except basally where slightly raised, densely villous, the epidermis yellow orange; **lateral veins** 5–7 per side, prominent below, slightly impressed above; **3° veins** raised below, slightly impressed above. **Male inflorescences** 3-flowered cymes; **pedicels** 1–2 mm long, densely pubescent. **Male flowering calyx** densely pubescent to wavy-hairy outside, hairs ascending, off-white, *tube* urceolate, 4 mm long, 3.5–4 mm wide, weakly winged, glabrous inside, *lobes* triangular, 4–5 mm long, 3–3.2 mm wide, ascending to slightly spreading, glabrous inside with a narrow intramarginal band; **male corolla tube** 5.5–6 mm long, 3 mm wide, the upper 1/2 sericeous outside, lower 1/2 with 3 shield-shaped glabrous basal areas, ± 1.8 mm long, bordered distally by minute curly ascending hairs; **male corolla lobes** rhombic, 3 mm long, 1.8–2 mm wide, sometimes involute basally. **Stamens** 12; **filaments** adnate to the base of the corolla in a single tier, rarely inserted on the receptacle, 2 mm long; **anthers** lanceolate, 2.3 mm long. **Female inflorescences** densely pubescent. **Female calyx** densely minutely sericeous outside, with sparse longer, wavy, ascending to spreading hairs, *tube* shallow-cupulate, 1.5 mm long, 4 mm wide, glabrate inside, *lobes* obtusely rounded, 6–7 mm long, 7–7.5 mm wide, densely hairy inside with a broad intramarginal band; **female corolla tube** 4.5 mm long, 3 mm wide, similar to male corolla tube, the glabrous basal regions 3 mm long, 2.2 mm wide; **female corolla lobes** rhombic, 3.5 mm long, 2 mm wide; **ovary** depressed-globose, 2 mm long, 3 mm wide, cream sericeous; **styles** 3, upright, not fused, 1.8 mm long, minutely sericeous abaxially, white tomentulose adaxially; **stigmas** 3, bifid; **staminodes** 3, the filaments adnate to the corolla base, 1.5–2 mm long, the sterile anther narrowly lanceolate, 1.5 mm long. **Fruiting pedicels** 2.5–6.5(–8) mm long, densely ascending-pubescent. **Fruiting calyx** explanate, densely puberulent outside, hairs cream to orange; *tube* (3–)4–5(–7) mm long, *lobes* broadly obtuse, (3.5–)4–8 mm long, (7–)8.5–12.5 mm wide, spreading to reflexed. **Fruit** globose, 1.5–2.5 cm in diameter, glabrous to sparsely puberulent, the hairs minute, straight, appressed to ascending, epidermis amber to dark yellow, green in living material when mature. **Seeds** 11–12.5 mm long, 8 mm radial depth, 5–6 mm wide.

This subspecies occurs in dry tropical forests, between 50 and 1100 m, in the southwest part of the Isthmus of Tehuantepec, Oaxaca (Fig. 40). It has been described as frequent at three sites with limestone substrates but has also been reported from sandy soils and disturbed sites. The occurrence of this taxon on Cerro Guiengola is significant because dry tropical forests of this region are considered high in quality, and have consequently been recommended for formal conservation following a study by Gordon et al. (2004). The species forms hybrids with *D. ae.* subsp. *rekoi* in the vicinity of Tehuantepec and in coastal regions near Salina Cruz, and in the Municipio of Santiago Astata.

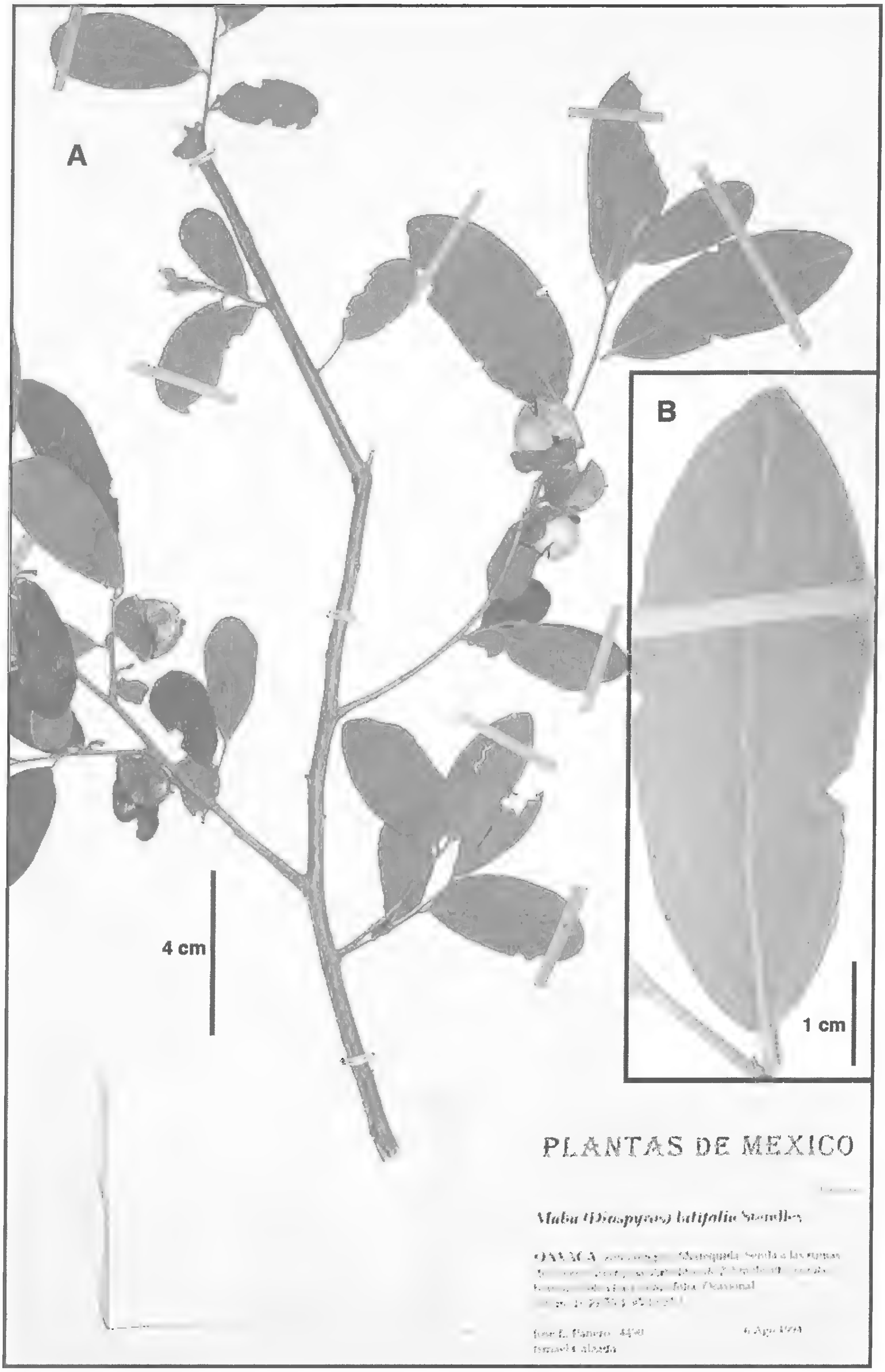
A
B
4 cm
1 cm
PLANTAS DE MEXICO
Maba (Diospyros) latifolia Standley

Fig. 36. Holotype of *D. aequoris* Standl. subsp. *tehuantepecensis* M.C. Provance, I. García & A.C. Sanders, subsp. nov. from Mixtequilla, Oaxaca (*J.L. Panero & J.I. Calzada 4490,* IEB-48849). **A.** Fruiting branchlet. **B.** Leaf (abaxial surface).

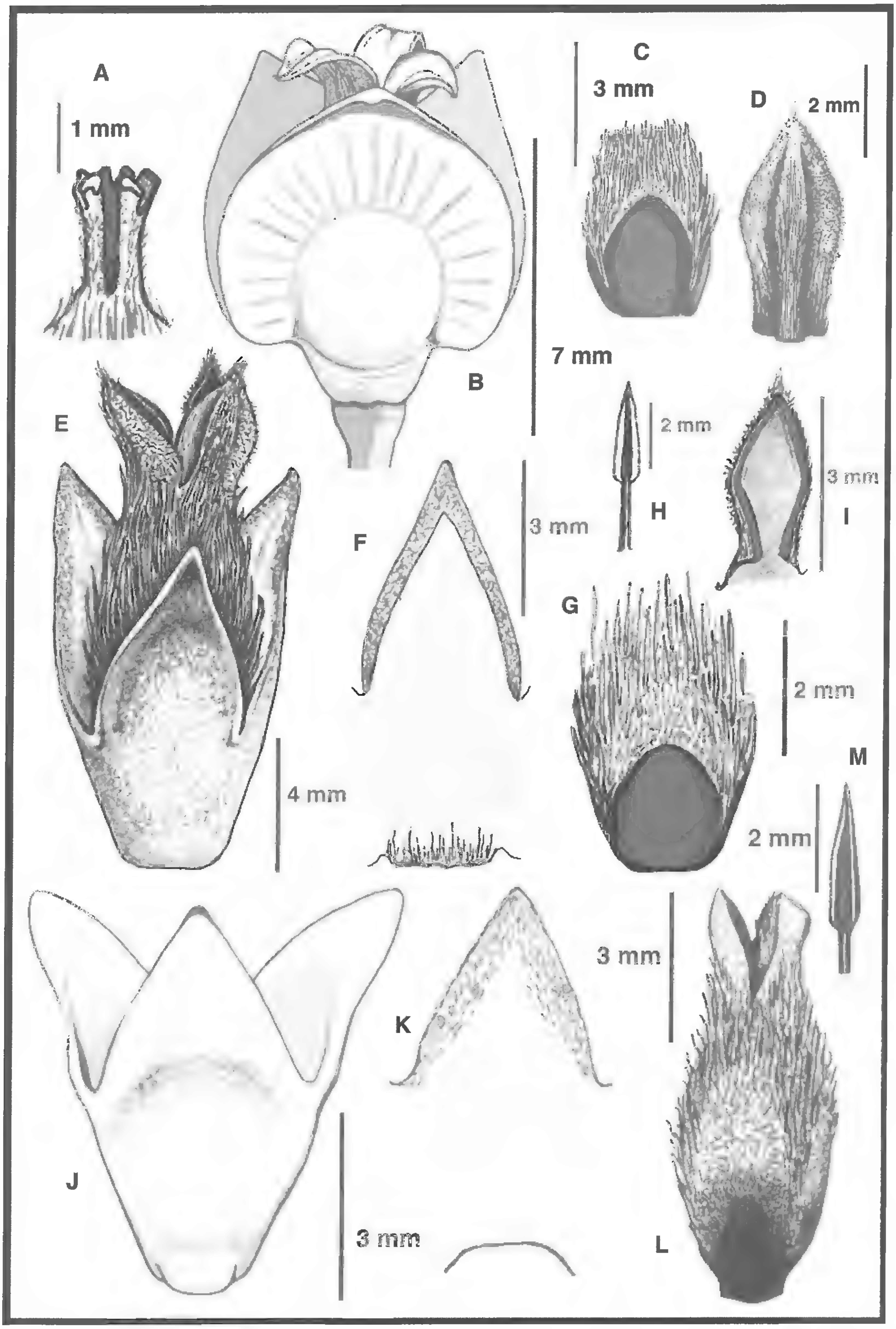

FIG. 37. *Diospyros aequoris* Standl. A–I. subsp. *tehuantepecensis.* A–D. Based on *J.L. Panero & J.I. Calzada 449* (CAS). A. Styles and stigmas. B. Female flower. C. Female corolla tube. D. Female corolla lobe (abaxial view). E–I. Based on *J. Rzedowski 33065* (MOU). E. Male flower. F. Adaxial surface of male calyx. G. Male corolla tube (adaxial view). H. Stamen. I. Male corolla lobe. J–M. subsp. *balsensis,* based on *G.B. Hinton 3959* (K) from Bejucos, Mexico. J. Male calyx. K. Adaxial surface of male flowering calyx. L. Male corolla. M. Stamen.

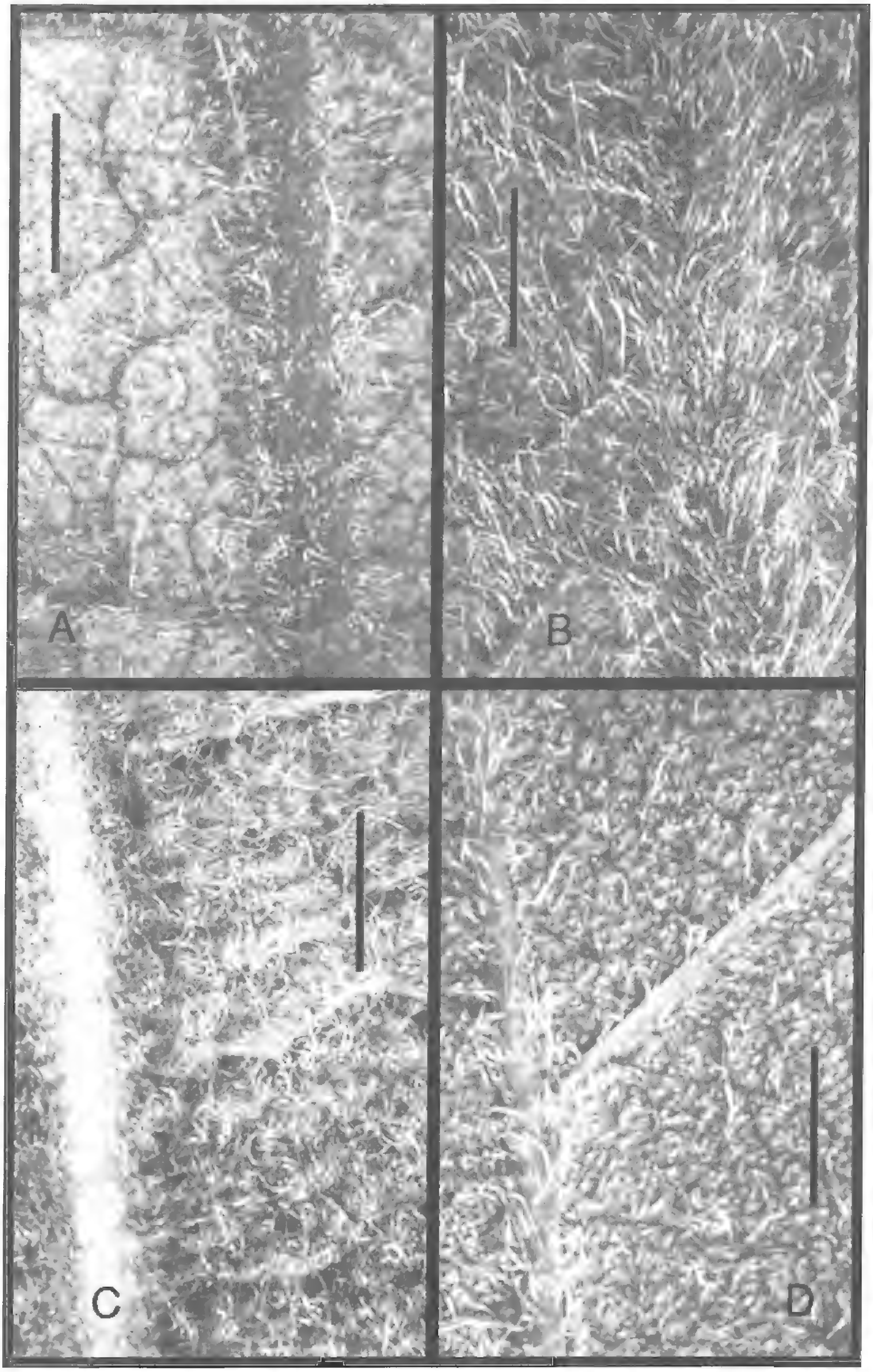

Fig. 38. Abaxial leaf vestiture *D. aequoris*, including midrib (scale = 1 mm). **A.** subsp. *rekoi* (*T. Salvato & M.C. Provance 487*, UCR). **B.** subsp. *aequoris* (*M.C. Provance et al. 9607*, UCR). **C.** subsp. *balsensis* (*M.C. Provance 9919*, UCR). **D.** subsp. *martineziana* (*M.C. Provance & I. Garcia R. 9396B*, UCR).

Representative specimens. **MEXICO. Oaxaca. Mpio. Guevea de Humboldt:** Cerro de Picacho, Jul 1914, *C.A. Purpus 7444, 7176* (MO). **Mpio. Ixtepec:** Cerro Blanco por la carretera Juchitán–Ixtaltepec, 200 m, 15 Feb 1982, *J.I. Calzada & J. Elizondo 8508* (XAL). **Mpio. Magdalena Tequisistlán:** 8 km al SW de La Pajima, 285–330 m, 29 Aug 1994, *G. Flores-Franco & J.I. Calzada 3621* (NLU, ARIZ). **Mpio. Magdalena Tlacotepec:** 4 km del ojo de agua de Tlacotepec hacia la Ollaga, 260 m, 26 Sep 1984, *R. Torres C. 6277* (MO). **Mpio. San Pedro Huamelula:** Playa Grande, 2.1 km al E, 50 m, 31 Jul 2000, *S. Salas M. 3213* (IEB). **Mpio. Santa Maria Jalapa del Marqués:** Rancho Ricardo, al N. de Buenos Aires, entrando por Hierba Santa, 12 Sep 1985, R. Torres C. & C. Martínez 7312 (MO). **Mpio. Santiago Lachiguirí:** Aproximadamente 10 km al NE de la cortina de la Presa Benito Juárez, camino de terraceria a Santiago Lachiguirí, 100 m, 24 Aug 1994, *G. Flores-Franco 3556 & J.I. Calzada* (ARIZ). **Mpio. Santo Domingo Ingenio:** 10 km al NE de La Ventosa, 2 Dec 1980, *R. Cedillo T. & D. Lorence 503* (ILL). **Mpio. Tehuantepec:** 22 km WNW de Tehuantepec, sobre la carr. a Oaxaca, 200 m, 22 May 1975, *J. Rzedowski 33065* (MOU); 5 km al SW de Tehuantepec, 40 m, 28 Jun 1982, *R. Torres C. & R. Cedillo T. 684* (CHAPA, MO); al O de Buenos Aíres, 15 km al O de Tehuantepec, 400 m, 5 Feb 1988, *C. Martínez R. 1288* (IEB); Piedra de Cal, 5 km al NO de Tehuantepec, 50 m, 18 Feb 1984, *P. Tenorio L. & R. Torres C. 5480* (MO, CHAPA); "Rancho Lizet," 6.3 km al SW de la entrada a Buenos Aíres, 190 m, 26 Mar 1984, *R. Torres C. & C. Martínez R. 4787* (MO, CHAPA); Cerro Guiengola, 1110 m, 27 Nov 1983, *R. Torres C. 4194* (CHAPA); Cerro Pozo Zorillo, entrando por Las Pilas, 8 Feb 1988, *C. Martinez R. 1297* (IEB); 20 km al O de Tehuantepec, entrando por Las Pilas, 5 Jan 1988, *C. Martínez R. 1158* (MO).

3. Diospyros salicifolia Humb. & Bonpl. ex Willd. Sp. Pl. Editio quarta 4:1112. 1806 (**Figs. 1, 2c, 39d, 41, 42, 43**). *Maba salicifolia* (Humb. & Bonpl. ex Willd.) Hiern, Trans. Cambridge Philos. Soc. 12:129. 1873. Type: MEXICO. Guerrero: near Acapulco, no date, *Humboldt & Bonpland s.n.* (holotype: B-W-19250-01, digital images!).

Diospyros albens C. Presl, Reliq. Haenk. 2:62. 1835. *Macreightia albens* (C. Presl) A. DC., Prodr. (DC.) 8:221. 1844. *Ebenus albens* (C. Presl) Kuntze, Revis. Gen. Pl. 2:408. 1891. Type. MEXICO. Guerrero: "Habitat ad portum Acapulco Mexicanorum," date unknown, *T. Haenke s.n.* (holotype: W-31942, as photo F!).

Trees, 1.5–6 m tall, facultatively deciduous; **trunk** unknown; **wood** unknown; **mature stems** terete, half-netted, glabrate sometimes black gland-dotted, epidermis tan; **2nd year stems** similar to mature stems; **1st year stems** quadrangular, becoming terete, moderately hairy, the hairs usually minute, thick, appressed, fluid-filled (the hairs throughout the plant are mostly simple glandular hairs, likely translucent in life, and the color of hairs in herbarium specimens is due to darkening of a fluid in the lumen), associated with glandular punctae, rarely some longer wavy subappressed hairs present near the tip of the growing shoot, lenticels narrowly elliptic, few in number, *bud scales* deeply concave, triangular, 1.5–2 mm long, moderately to densely hairy, the hairs strongly appressed, similar to those on the young stems, glandular punctate, sometimes with minute clavate glandular hairs. **Leaves** alternate, simple, entire, closely spaced on new growth; **petioles** subterete, at least distally, (2–)3–5 mm long, sparsely to moderately hairy above and below, the hairs wavy, appressed to ascending, yellowish; **lamina** chartaceous, narrowly elliptic to oblong, oblanceolate, sometimes obovate, 60–80(–110) mm long, 22–32(–35) mm wide, the length to width ratio (2.3–)2.5–3.2 : 1, somewhat revolute, at least along the lower 1/2 of the margins, *apex* broadly to acutely rounded, *base* rounded to the petiole, very rarely cuneate; **lower lamina surface** moderately hairy in immature leaves, glabrate to sparsely hairy when mature, the hairs 0.2–0.9 mm long, appressed to subappressed, straight, or nearly so, more frequent in the basal 1/4 of the leaf, sparsely to moderately clavate glandular hairy, the glandular hairs amber colored, the epidermis gray in herbarium material, sometimes viscid, the stomatal apparatus often opaque, white, and conspicuous; **upper lamina surface** glabrous to sparsely pubescent with weak hairs, the epidermis weakly papillate, brown to dark gray and somewhat shiny in herbarium material, epidermal cells conspicuous with age. **Venation** brochidodromous to arcolanguid; **midrib** narrow and prominent on the lower surface, usually ≤ 1 mm wide, sparsely to moderately hairy, the hairs 0.3–0.9 mm long, slightly wavy to nearly straight, subappressed; the midrib raised proximally on the upper surface, convex, narrowing distally, becoming flush with the lamina, glabrate to sparsely pubescent, rarely moderately pubescent, the hairs ± wavy, the epidermis light yellow above and below; **lateral veins** 6–9 on each side of the midrib, diverging from midrib between 45–90°, rounding towards the apex distally, intersecondary veins inconspicuous; **3° veins** usually faint below, sometimes slightly darkened and more apparent, faintly raised or not apparent on the upper surface; **4° veins** sometimes slightly darkened and apparent below. **Laminar extrafloral nectaries** 0.2–0.6(–0.8) mm in dimension, circular to elliptic. **Male inflorescences** solitary (1–)2–3-flowered cymes in leaf axils of young stems (our description of the male inflorescence and

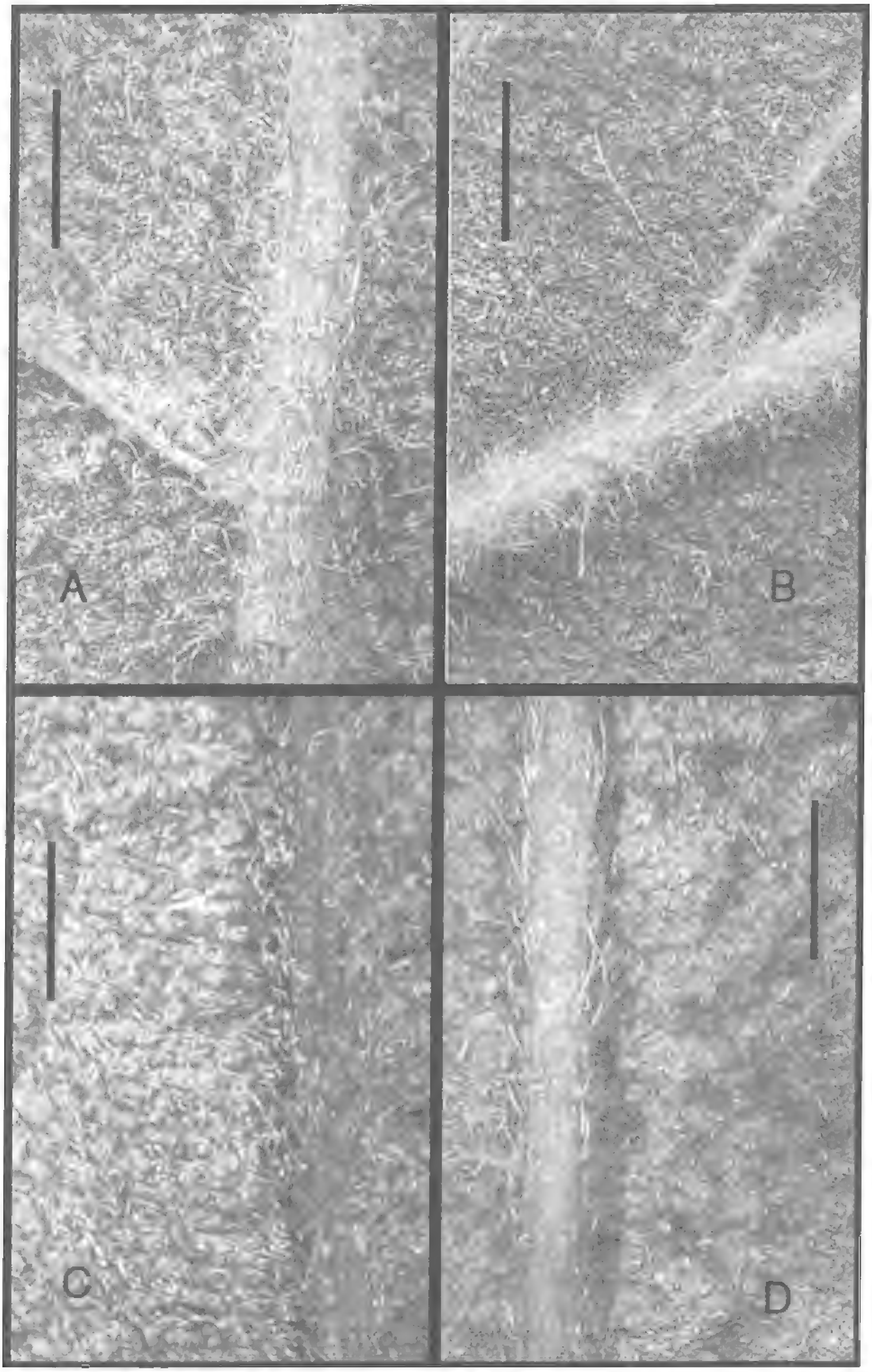

Fig. 39. Abaxial leaf vestiture, including midrib (scale = 1 mm). **A.** *D. aequoris* subsp. *chutlensis* (from the holotype). **B.** *D. aequoris* subsp. *tehuantepecensis* (from the holotype). **C.** *D. aequoris* subsp. *chutlensis* (*M.C. Provance 9930*, UCR). **D.** young leaf, *D. salicifolia* (*W. Boege 452*, FR).

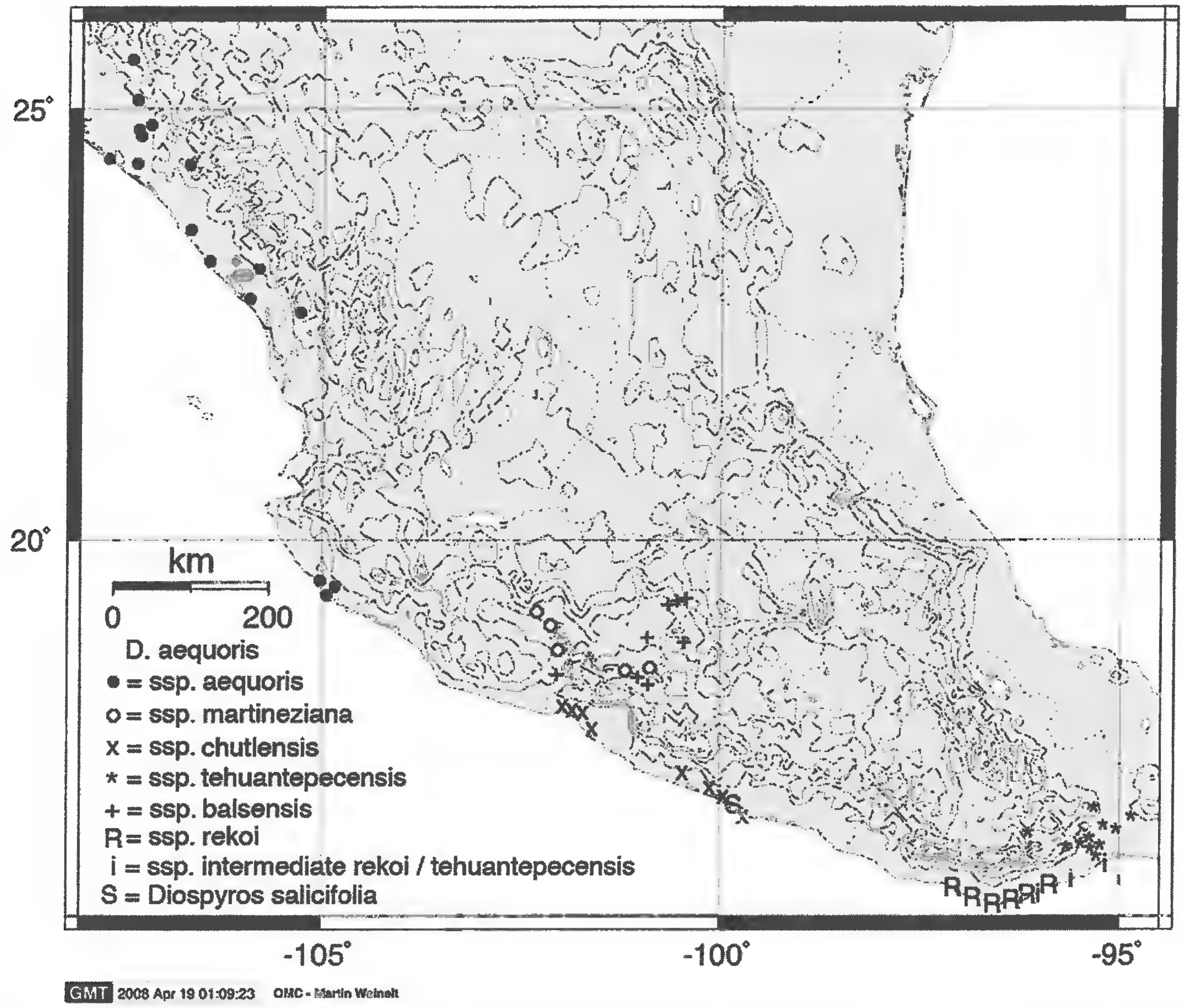
25°
20°
km
0
200
D. aequoris
● = ssp. aequoris
o = ssp. martineziana
x = ssp. chutlensis
* = ssp. tehuantepecensis
+ = ssp. balsensis
R = ssp. rekoi
i = ssp. intermediate rekoi / tehuantepecensis
S = Diospyros salicifolia
-105°
-100°
-95°
GMT 2008 Apr 19 01:09:23 OMC - Martin Weinelt

Fig. 40. Distribution of *Diospyros aequoris* Standley and *D. salicifolia* Humb. & Bonpl. ex Willd.

flowers is approximate, and lacks detail because the only male specimen we have seen is a photo of the type of *D. albens*); **peduncles** 2 mm long; **pedicels** 1–1.7 mm long. **Male flowers** 3-merous; **male flowering calyx** narrowly campanulate, *tube* 2 mm long, 2 mm wide, *lobes* valvate-reduplicate in the bud, narrowly triangular, 3–5.5 mm long, 2.2 mm wide; **male corolla tube** urceolate, 3 mm long, 2 mm wide, sericeous; **male corolla lobes** 2.5 mm long. **Stamens** of unknown number; **filaments** at least sometimes adnate to the corolla near the base; **anthers** lance-ovate, 1.5–2 mm long, opening by longitudinal slits. **Female inflorescences** solitary flowers in leaf axils of young stems; **female flowering pedicels** 3–5 mm long, vestiture similar to that of young stems. **Female flowers** 3–4-merous; **female flowering calyx** mitriform, exterior moderately hairy, the hairs very minute, subappressed, light yellow to amber, apparently borne from glandular punctae, these most obvious near the sepal margins, *tube* cupulate, 1.2–1.8 mm long, 3 mm wide, interior unknown, *lobes* valvate-reduplicate in the bud, ovate to widely ovate, winged, 6.5 mm long, 6.5 mm wide, faintly 3–6-veined; **female corolla** unknown; **ovary** unknown; **styles** (based on remnants on fruits) 3, fused into a column with a dark basal band, densely wavy-hairy, the hairs cream to amber; **stigmas** unknown. **Fruiting pedicels** 2–5 mm long, bracts 2, ± opposite, deltoid, 0.3 mm long. **Fruiting calyx** slightly accrescent, explanate to rotate, the exterior glabrate to sparsely hairy, the hairs slightly wavy to straight, subappressed; epidermis glandular punctate, glands often black, *tube* 3–4.5(–6) mm long, not bulbous at the base, interior lower 1/2 glabrous, otherwise moderately white hairy, the hairs long, fine, glossy,

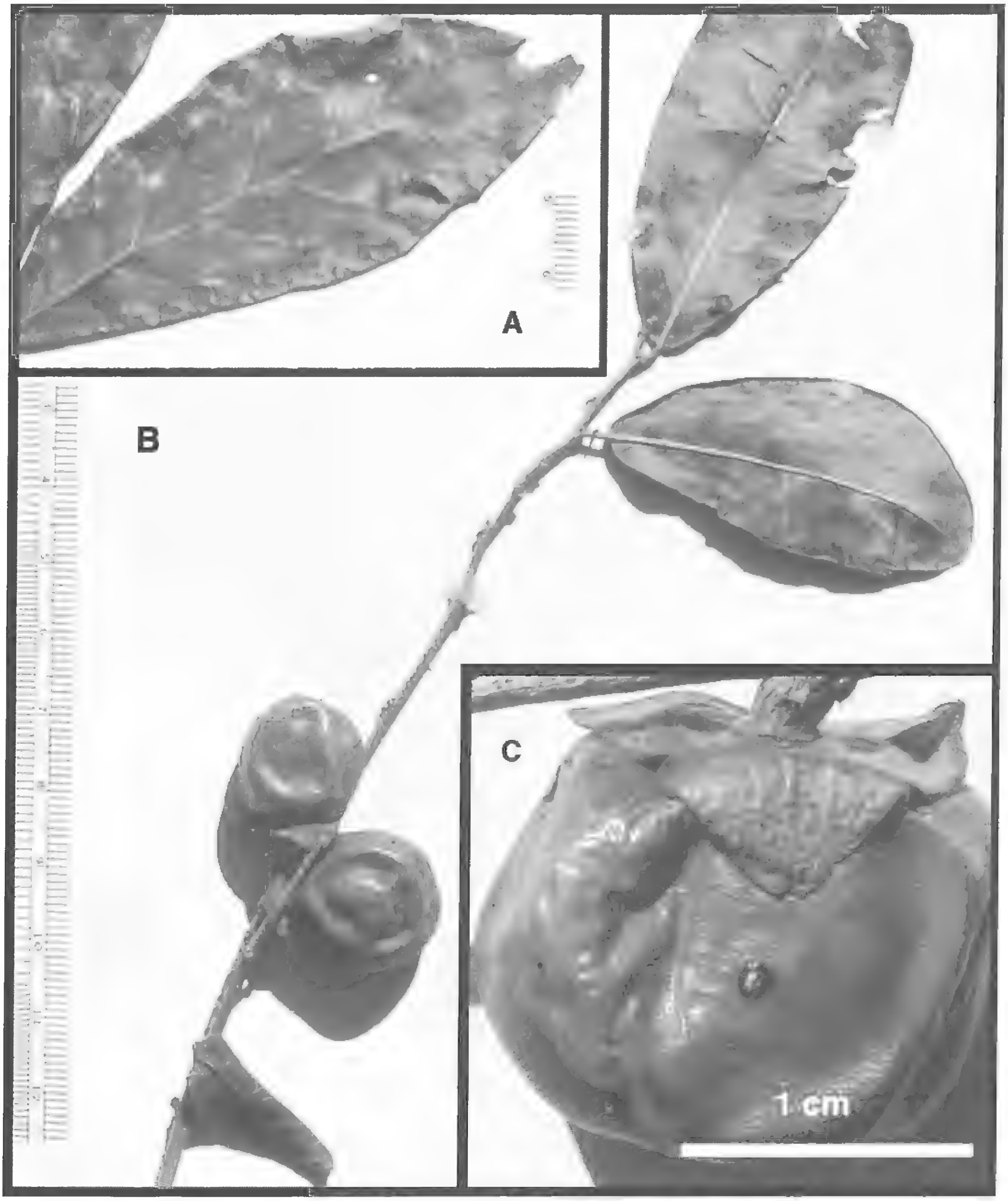

Fig. 41. ***Diospyros salicifolia*** **from Revolcadero [Acapulco Vicinity] (*W.L. Forment 1317*, SD). A. Adaxial surface of leaves. B. Fruiting branchlet. C. Detail of fruit and fruiting calyx. P. Adaxial surface of male flowering calyx. Q. Male corolla tube. R. Male flower. S. Stamen.**

straight and appressed, *lobes* spreading, broadly ovate to oblong-ovate, 4–6(–6.5) mm long, 8–10 mm wide, sometimes acuminate, often reflexed along the margins, with a wide interior intramarginal band of hairs, the hairs dense, minute, curly, the median similar to the upper 1/2 of the fruiting calyx tube. **Fruit** a ± globose berry, 2–2.5 cm in diameter, with three pairs of locules; **flesh** probably gelatinous when fresh, vitreous, red

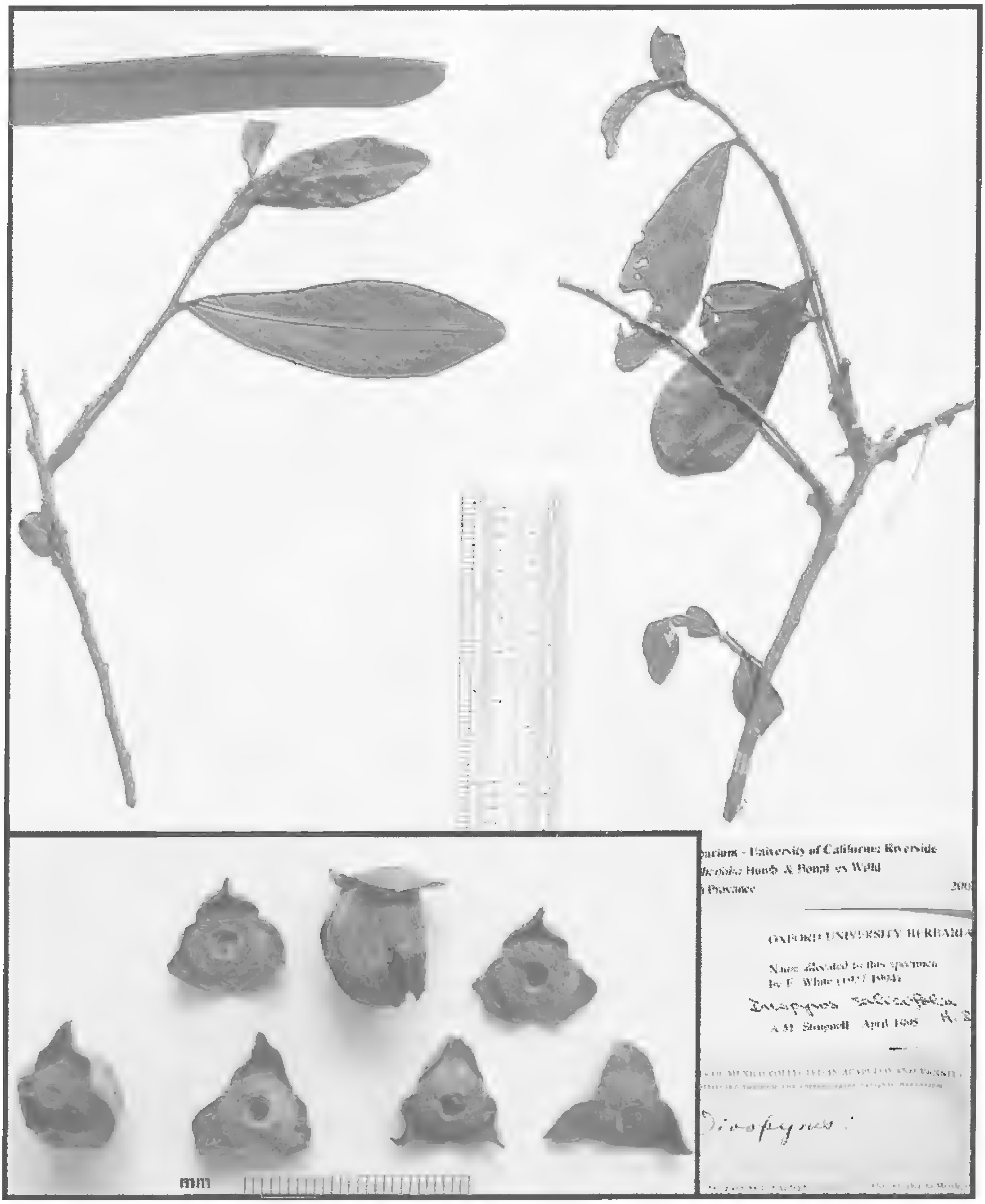

Fig. 42. Fruiting branchlet of *Diospyros salicifolia* (*E. Palmer 372*, MO), with detail of fruit and fruiting calyx.

and translucent upon drying; **epidermis** smooth to orange-peel textured, sparsely to moderately hairy near apex and base of the fruit, otherwise glabrous or scantily appressed hairy, the epidermis yellow to dark yellow when mature, often pruinose. **Seeds** 5–6, wedge-shaped (resembling an orange segment with rounded edges), 15 mm long, 8 mm radial depth, 6 mm wide, reddish-brown, texture granular-foveolate.

Diospyros salicifolia is endemic to dry tropical forest and littoral scrub between 1 and 100 m, in the vi-

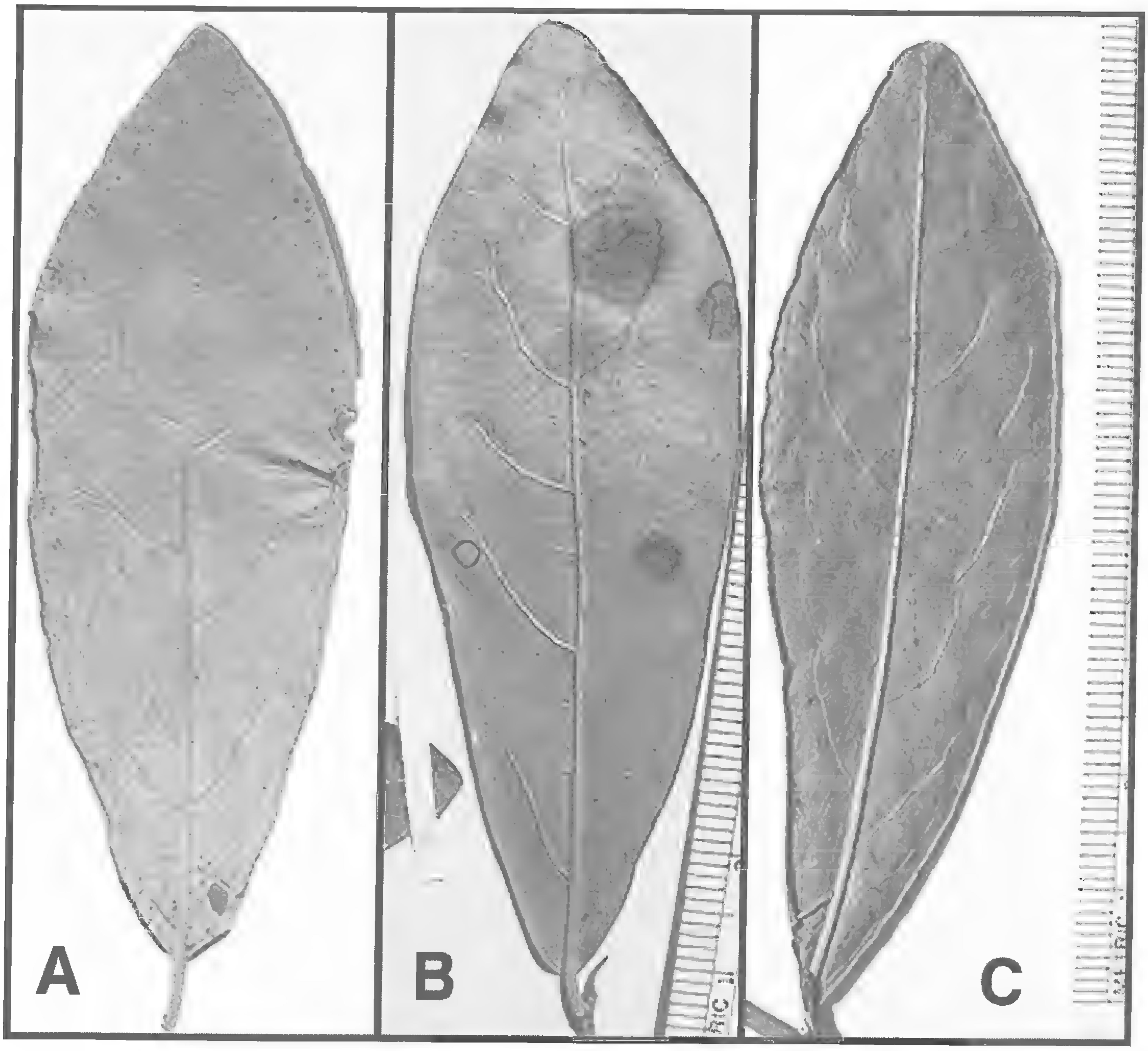

Fig. 43. Detail of abaxial surface of leaves of *Diospyros salicifolia*. A. Young leaf from Copacabana [near El Marques, Acapulco Vicinity], Guerrero (*W. Boege 452*, FR). B. From Puerto Marqués, Guerrero (*W.L. Forment 1338*, XAL). C. From Acapulco and vicinity (*E. Palmer 372*, MO).

cinity of Acapulco and Isla Roqueta (Isla Grifo) at the mouth of Acapulco Bay, Guerrero (Fig. 40). Protected forests exist in the vicinity of Acapulco, but it is unknown if the species occurs in these areas. Because of its restricted range, apparent association with littoral scrub, and proximity of a rapidly developing tourism center, the species should be considered threatened. Local names associated with this species include "tamalototzin" and "sapotillo." The fruiting calyx of this species is quite small and similar to *D. aequoris* subsp. *chutlensis*. However, the leaves of *D. salicifolia* are longer and have a greater lamina shape ratio. The foliage of collections of *D. acapulcensis* subsp. *veraecrucis* from coastal regions of Chiapas sometimes resembles *D. salicifolia*, but fruiting calyces have the longer tube typical of subsp. *veraecrucis*. Material from this region should be evaluated more thoroughly when more collections are available.

Representative specimens. **MEXICO. Guerrero. Mpio. Acapulco de Juarez:** Isla Roqueta, *I.K. Langman 3305* (NA); portum Acapulco, *Haenke 31942* (W photo); Copacabana [location near El Marques, 16°46'12"N, 99°47'24"W, 1–3 m, (The label incorrectly places Copacabana in "Puebla/Tlaxcala." The date is suspect also.), 15 Jul 1966, *W. Boege 452* (FR); Viveros El Huayacán, La Poza, 22 May 1979, *W.L. Forment 790* (XAL); 2 km W de Puerto Marqués, 19 Jan 1981, *W.L. Forment 1388* (CAS, JBSD, MO); Puerto Marqués, 28 Jan 1981, *W.L. Forment 1338* (XAL); Acapulco and vicinity, Oct 1894–Mar 1895, *E. Palmer 372* (MO); Revolcadero, 27 Jan 1981, *W.L. Forment 1317* (SD, XAL).

4. Diospyros yucatanensis Lundell. Publ. Carnegie Inst. of Wash. 478:217. 1937. Type: GUATEMALA. Petén. San Andres [as on label], "collected on the steep north bank of Lake Petén near San Andres" [protologue], 4 May 1933, *Lundell 3237* (holotype: MICH; isotype: F-685309, as image!, LL).

Trees or shrubs, 2–15(–28) m tall, facultatively deciduous, dioecious; **trunk** often relatively tall and slender, otherwise unknown; **wood** unknown; **mature stems** terete, half-netted to finely reticulated, glabrous, epidermis dark reddish-brown to grayish-brown, sometimes lenticellate, sometimes black gland dotted; **2nd year stems** subterete to terete, nearly smooth, minutely ridged or sulcate, glabrous to densely hairy, the hairs when present often pale and desiccated; **1st year stems** angular to subterete, sometimes rugulose, moderately to densely hairy, the hairs short, wavy to curly, sometimes longer and nearly straight, orangish to reddish-brown (the hairs throughout the plant are mostly simple glandular hairs, likely translucent in life, and the color of hairs in herbarium specimens is due to darkening of a fluid in the lumen), clavate glandular hairs sometimes present, deciduous, leaving the epidermis viscid, sometimes scintillant, sometimes pruinose, reddish-brown. **Leaves** alternate, simple, entire; **petioles** (2–)3.5–8(–8.5) mm long, sometimes winged, often only distally, glabrous to densely hairy, epidermis usually rugose, often viscid, sometimes glaucous, sometimes pruinose, sometimes scintillant, golden to very dark brown, barely canaliculate to convex above; **lamina** chartaceous, (52–)59–106(–123) mm long, 19–41(–48) mm wide, length to width ratio (1.8–)2.1–3.5(–4) : 1, lanceolate or ovate, sometimes oblanceolate, obovate, or elliptic, at 3/4 length mostly 12–30(–35) mm wide, *base* acute and short attenuate to broadly rounded, usually somewhat decurrent on the petiole, *margins* flat to slightly revolute, *apex* acuminate to acute, sometimes rounded; **lower lamina surface** glabrate to densely hairy, curly to slightly curved, sometimes straight, cream to tawny to bright orange-red, hair bases usually swollen and ± papillose, epidermis grayish, sometimes viscid, the stomatal apparatus usually opaque and conspicuous; **upper lamina surface** glabrous to moderately hairy, the hairs wavy, upright, epidermis sometimes shiny, sometimes crystal-papillose. **Venation** brochidodromous to arcolanguid, the epidermis yellowish to reddish-brown and sometimes viscid below; **midrib** prominent below, glabrous to densely hairy, the hairs short, curly, with some longer, straight, subappressed, bright reddish-brown hairs; **lateral veins** 5–8 on each side of the midrib, their courses mostly arching, thin but ± prominent below, often with long, straight, bright reddish-brown hairs, fine and barely raised to flush above, impressed along the lamina-vein seam; **3° veins** subprominent below, though usually somewhat obscured by the vestiture, usually obscure above, sometimes slightly impressed; **4°–5° veins** obscure. **Laminar extrafloral nectaries** usually on basal half of leaf, often near midrib, sometimes on intersecondary veins, mostly elliptic, 0.3–1 mm long, concave. **Male inflorescences** 1–5-flowered cymes in leaf axils on young stems, densely hairy, the hairs minute, curly to wavy, reddish; epidermis viscid and dark brown; **peduncles** 2–6 mm long; **pedicels** 1–3 mm long, bracts ovate or deltoid to linear lanceolate, 1–3 mm long. **Male flowers** 3–4-merous; **male flowering calyx** narrowly campanulate, exterior moderately to densely hairy, the hairs straight to curly, golden to reddish, the epidermis reddish-brown, *tube* 3–5.5 mm long, 3.5–5.5 mm wide, interior entirely glabrous, or glabrous in the lower half and densely hairy above, the hairs straight, appressed, *lobes* valvate-reduplicate in the bud, oblong-ovate to lance-ovate or triangular, 2–4 mm long, 2.8–3.5 mm wide, acute to subacute, sometimes barely acuminate, interior intramarginal band narrow, moderately to densely hairy, the hairs minute and curly, the median hairs moderate to dense, the hairs straight or nearly so, appressed to subappressed; **male corolla** white, yellowish or pinkish; **male corolla tube** cylindrical, narrowing distally, 6–10 mm long, 3–4 mm wide, exterior with 3 small shield-shaped glabrous regions at base, or with a narrow glabrous basal band, sometimes with minute wavy hairs just distal to glabrous areas, otherwise tawny to reddish sericeous with a dense undercoat of minute curly hairs; **male corolla lobes** oblong-ovate, 3–5 mm long, 1–2.3 mm wide, exterior densely hairy, the hairs curly to straight, subappressed to ascending, reddish-gold to brownish, the epidermis reddish to dark reddish-brown. **Stamens** 10–14; **filaments** adnate to the corolla at or near the base, in two well-defined tiers, or with a few stamens inserted on the receptacle, sometimes a few geminate, (1.5–)2–3.5 mm long; **anthers** lanceolate to ovate or oblong-ovate, 2.3–4.5 mm long, lower anthers usually shorter, apex sometimes rostrate or cuspidate, sometimes thickened or granular near the apex; **pistillode**

minute, hairs dense, wavy or straight. **Female inflorescence** solitary flowers in leaf axils of young stems, the vestiture similar to male inflorescences; **female flowering pedicels** with hairs and epidermis similar to male inflorescences. **Female flowers** 3–4(–5)-merous; **female calyx** mitriform, sometimes narrowly winged, *tube* 2.5–3.3 mm long, 4–5 mm wide, *lobes* valvate-reduplicate in the bud, bluntly acute to slightly rounded, 3.3–6 mm long, 3.5–5.5 mm wide; **corolla tube** urceolate, narrowing distally, 3–5 mm long, 2.5–3 mm wide, exterior reddish sericeous except for some glabrous parts near the base; **corolla lobes** lance-ovate to ovate, 3.5–4.5 mm long, 1.5–2.5 mm wide; **ovary** ovoid, sericeous, the hairs reddish and fluid-filled; **styles** 3, columnar to spreading; **stigmas** bifid; **staminodes** sometimes present. **Fruiting pedicels** 2–14(–16) mm long, broadening distally, glabrate to densely hairy, the hairs short, wavy, subappressed to appressed, often pale and desiccated on mature fruit, epidermis reddish to brownish, bracts not seen. **Fruiting calyx** rotate to explanate, exterior hairs similar to fruiting pedicels, *tube* 3–6(–7.5) mm long, interior sparsely to densely hairy, the hairs very short, fine, straight and appressed, but glabrous in the basal 1/8–1/3, *lobes* accrescent, broadly rounded to oblong, 3–10(–12) mm long, (7–)9–14(–15) mm wide, spreading to reflexed, the margin sometimes conspicuously undulate, tip rounded, tapered or barely acuminate, sometimes appearing narrowed to a point due to folding of the distal margin, intramarginal band very wide, sparsely to moderately hairy, the hairs minute, curly, erect to ascending, amber; the epidermis puncticulate viscid; median sparsely to moderately hairy, the hairs similar to those of inner calyx tube, present only near the base of lobe. **Fruit** a globose to depressed-globose berry, 1.5–2.5 cm in diameter, sometimes umbilicate, often partly dehiscent, consistently with three pairs of locules, immature fruit sparsely reddish-brown hairy, mature fruit glabrate except near apex where hairs may be dense, and at base where a ring of subappressed, fine, straight hairs is sometimes present (the ring sometimes adhering to the base of the fruiting calyx tube); **flesh** gelatinous; drying vitreous, reddish and translucent; **epidermis** texture ± orange-peel like, often pruinose, scintillant, sometimes glaucous, golden brown to reddish-brown, sometimes yellow. **Seeds** shaped like orange segments, texture rugulose-foveolate, 11–14 mm long, 6–7 mm radial depth, 4–5 mm wide.

The range of this species includes the Yucatan Peninsula, the highlands of northern Chiapas, Tabasco, southeast Veracruz, and northeast Guatemala (Fig. 49). The southern limit of its range seems to be near Lake Izabal, Guatemala. Collections from "El Rancho" on the southern slopes of the Sierra de las Minas in Guatemala are difficult to place, and are thought to represent hybrids between the nominate subspecies of *D. yucatanensis* and *Diospyros acapulcensis* subsp. *nicaraguensis*. The species seems to be associated with thin rocky soils throughout its range. Lundell (1937) described two species in the *salicifolia* complex for the Yucatan Peninsula: *Diospyros yucatanensis* and *D. spectabilis*. We recognize only one species, *Diospyros yucatanensis*, separated from other members of the complex based on differences in leaf shape and several inflorescence size and shape parameters. *Diospyros yucatanensis*, even when sterile, is easily separable from *D. aequoris* and *D. acapulcensis*. Its leaves are frequently lanceolate to lance-ovate, a feature not seen elsewhere. On the abaxial surface of the leaf the hair bases are usually swollen and slightly viscid. This gives a characteristic papillose appearance to older leaves that have lost their hair shafts. Characteristics of some floral features also seem be of taxonomic significance, such as the longer corolla tube, differences in the distribution of the external vestiture on the corolla tube, and a trend toward fourteen stamens rather than twelve. However, it would be desirable to evaluate the constancy of these characters further when there is access to larger samples of flowers. We have reduced *D. spectabilis* to subspecific status under *D. yucatanensis* because it shares the aforementioned leaf characters and trends in floral morphology, and because intermediates between the taxa are common. Still, *D. y.* subsp. *spectabilis* warrants subspecific recognition because throughout most of its range it can be differentiated from the nominate subspecies by its longer pedicels, longer and distinctively shaped fruiting sepals, and generally narrower leaves. The ranges of the two taxa are more or less parapatric.

KEY TO THE SUBSPECIES OF *DIOSPYROS YUCATANENSIS* IN MESOAMERICA

1. Fruiting pedicels 2–6(–8) mm long; calyx lobes 3–6(–8) mm long; lamina wide, especially in the upper-half, usually 19–30 mm wide at 3/4 length; usually < 350 m, but occasionally to 1400 m ____________ subsp. **yucatanensis**

1. Fruiting pedicels mostly 6–16 mm long; calyx lobes 4.5–10(–12) mm long; lamina narrow, especially in the upper-half, usually 12–23 mm wide 3/4 length; < 250 m____________________ subsp. **spectabilis**

4a. Diospyros yucatanensis Lundell subsp. **spectabilis** (Lundell) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov. (**Figs. 44, 45, 47p–s, 48a–b**). Basionym: *Diospyros spectabilis* Lundell, Publ. Carnegie Inst. Wash 478:218. 1937. Type: MEXICO. Campeche: Tuxpeña, "secondary swamp forest at Tuxpeña" [protologue], [18°27'N, 90°5'W, 213 m], 11 Oct 1931, *C.L. Lundell 807* (holotype: MICH; isotypes: K!, LL, MO, as digital image!, WIS!).

Trees or shrubs, 2–10(–14) m tall; **trunk** up to 13 cm in diameter; **mature stems** glabrous, rarely with remnant hairs in the 2nd year, the young stems glabrate to sparsely villosulous, some hairs subappressed, the epidermis viscid, pruinose, scintillant. **Petioles** (2–)3.5–8(–8.5) mm long, sometimes with a thin wing, rugose, golden to dark reddish-brown, sometimes pruinose and scintillant, viscid, glabrous to sparsely pubescent or wavy-hairy below, the hairs appressed to subappressed, ascending to subappressed villosulous above. **Lamina** lanceolate or ovate to elliptic, sometimes oblanceolate or obovate, (52–)59–96(–123) mm long, 19–38(–48) mm wide, length to width ratio (1.8–)2.1–3.5(–4) : 1, lamina at 0.75 length 12–24(–35) mm wide, *base* acute, sometimes obtuse, short attenuate and abruptly decurrent on the petiole, *margins* slightly revolute, *apex* acuminate or acute, sometimes rounded; **lower lamina surface** glabrate to tomentulose, the cream, tawny, or reddish hairs readily deciduous, the hair bases swollen, giving a dense papillose appearance to the reddish-brown to gray epidermis, the stomatal apparatus dense, usually opaque and conspicuous; **upper lamina surface** glabrous to sparsely villosulous, epidermis viscid and shiny. **Venation** brochidodromous to arcolanguid; **midrib** below glabrous to densely reddish-brown hairy; **lateral veins** finely raised below, usually impressed along the lamina-vein seam above; **3° veins** barely raised below, slightly impressed above. **Male inflorescences** 1–3-flowered cymes, tomentulose and sparsely subappressed pubescent; **peduncles** 4–6 mm long; **pedicels** 2–2.5 mm long, bracts ovate to deltoid, 1–1.3 mm long, ± concave, readily deciduous. **Male flowering calyx** moderately to densely reddish-gold puberulent outside, the hairs minute, ± straight, not overlapping, *tube* 3–4 mm long, 3.5–4 mm wide, glabrous inside, or with scattered hairs below the sinuses, *lobes* oblong-ovate to lance-ovate, 2–4 mm long, 3.5 mm wide, acute or barely acuminate, minutely sericeous inside with a narrow intramarginal band; **male corolla tube** 6–7.5 mm long, 3.2 mm wide, sericeous and either glabrous for 0.5–0.8 mm basally, or with 3 minute shield-shaped glabrous basal regions; **male corolla lobes** lanceolate to lance-ovate, 3.5–5 mm long, 1–1.8 mm wide, the hairs reddish-gold. **Stamens** 10–14; **filaments** adnate to the corolla ± basally in two well-defined tiers, 2–2.5 mm long, red; **anthers** lanceolate to lance-ovate, 2.3–3 mm long. **Female inflorescences** 7–9 mm long, bracts unknown. **Female flowering calyx** narrowly winged, densely reddish subappressed wavy-hairy outside, sometimes with some straight ascending hairs, vestiture inside unknown *tube* 3.3 mm long, 4 mm wide, *lobes* acute, 3.3 mm long, 3.5 mm wide; **corolla tube** 4–5 mm long, ± 3 mm wide, reddish sericeous outside, otherwise unknown; **corolla lobes** lance-ovate, 3.5–4.5 mm long, 1.5 mm wide. **Pistil** unknown except **style remnants on immature fruit** 3 in number. **Fruiting pedicels** (3–)5–14(–16) mm long, glabrate to moderately hairy, viscid. **Fruiting calyx tube** 3–6(–7.5) mm long, upper 2/3 sparsely to moderately hairy inside, lower 1/3 glabrous, *lobes* rapidly and markedly accrescent, broadly rounded to oblong, (3.5)4–10(–12) mm long, (8–)9–14(–15) mm wide, rounded to barely acuminate to a blunt point, spreading to reflexed, margins reflexed at the sinus and along the distal margin conferring the appearance of a narrowly acute to acuminate point, sparsely to moderately hairy inside with a wide intramarginal band. **Fruit** globose to depressed-globose, sometimes umbilicate, immature fruit sparsely reddish-brown hairy, mature fruit glabrous except moderately hairy at the apex.

This northern subspecies grows on thin, rocky, calcareous soils in deciduous and subdeciduous forests, and secondary growth derived from these vegetation types. It occurs below 250 m elevation throughout the Yucatan Peninsula, Mexico, (Fig. 49), in the states of Campeche, Quintana Roo, and Yucatan. It also has a limited range in northeast Guatemala and Belize. This taxon is separable from the nominate subspecies by its longer fruiting pedicels, longer and slightly wider fruiting sepals, and slightly shorter and narrower lamina. There seems to be a difference in lamina pubescence, but it is subtle, and of limited use since lamina

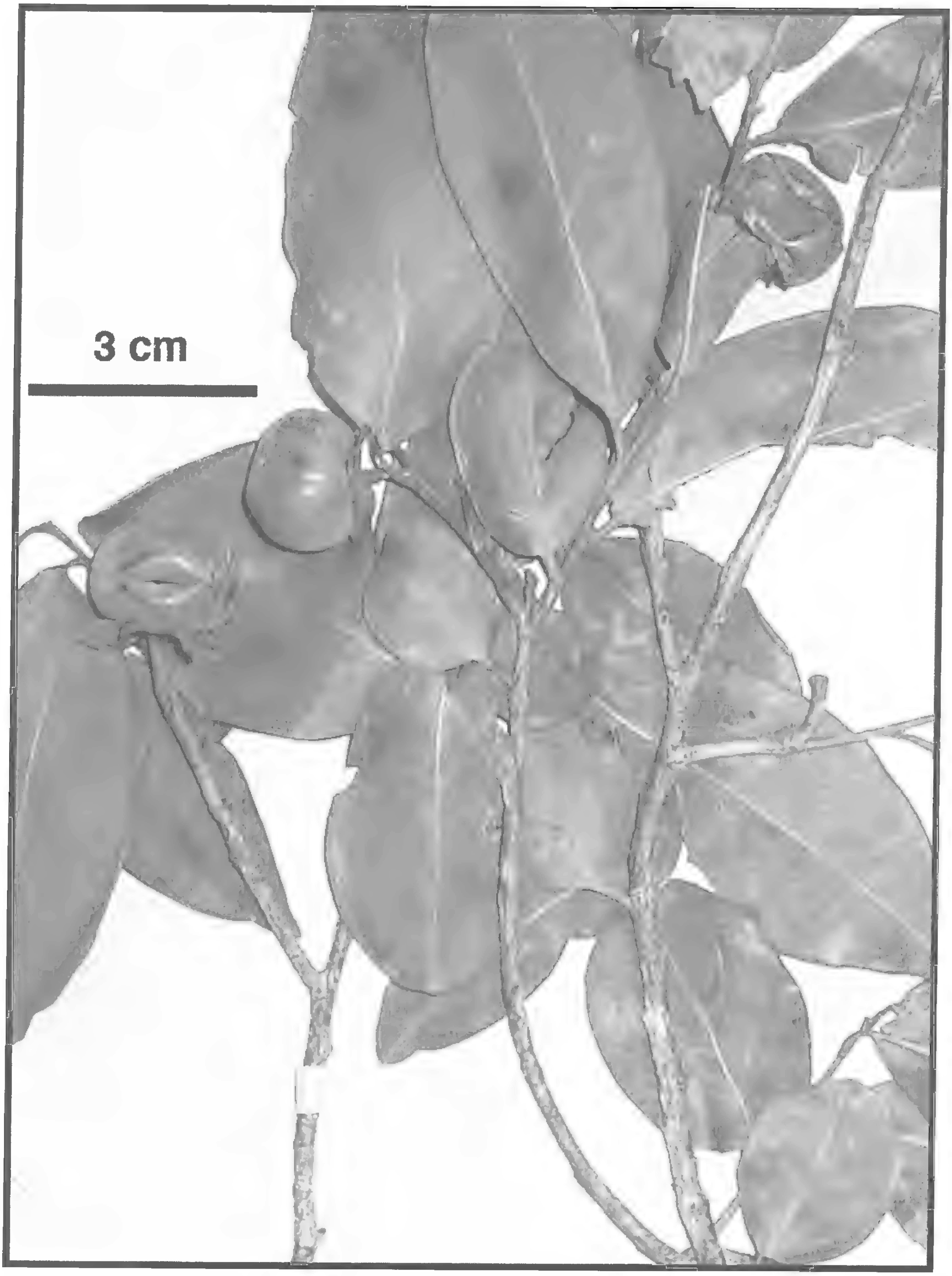

Fig. 44. Isotype of *D. spectabilis* Lundell (*D. yucatanensis* Lundell subsp. *spectabilis* (Lundell) M.C. Provance, I. García & A.C. Sanders, comb. nov.), from Tuxpeña, Campeche, Mexico, *C.L. Lundell 807* (WIS).

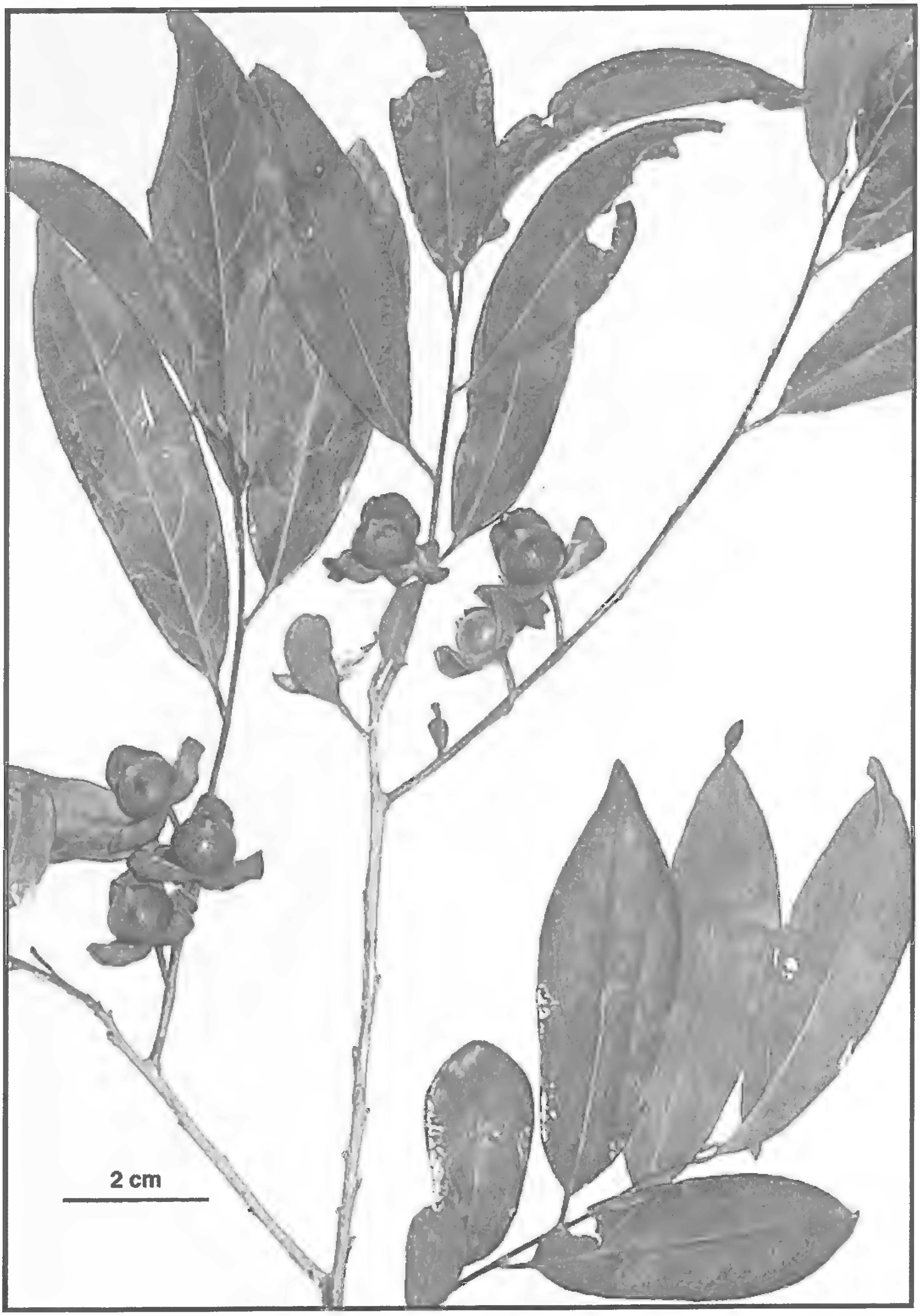

FIG. 45. *Diospyros yucatanensis* subsp. *spectabilis* from Maxcanú, Yucatan, Mexico, *C. Chan 6864* (CIQR).

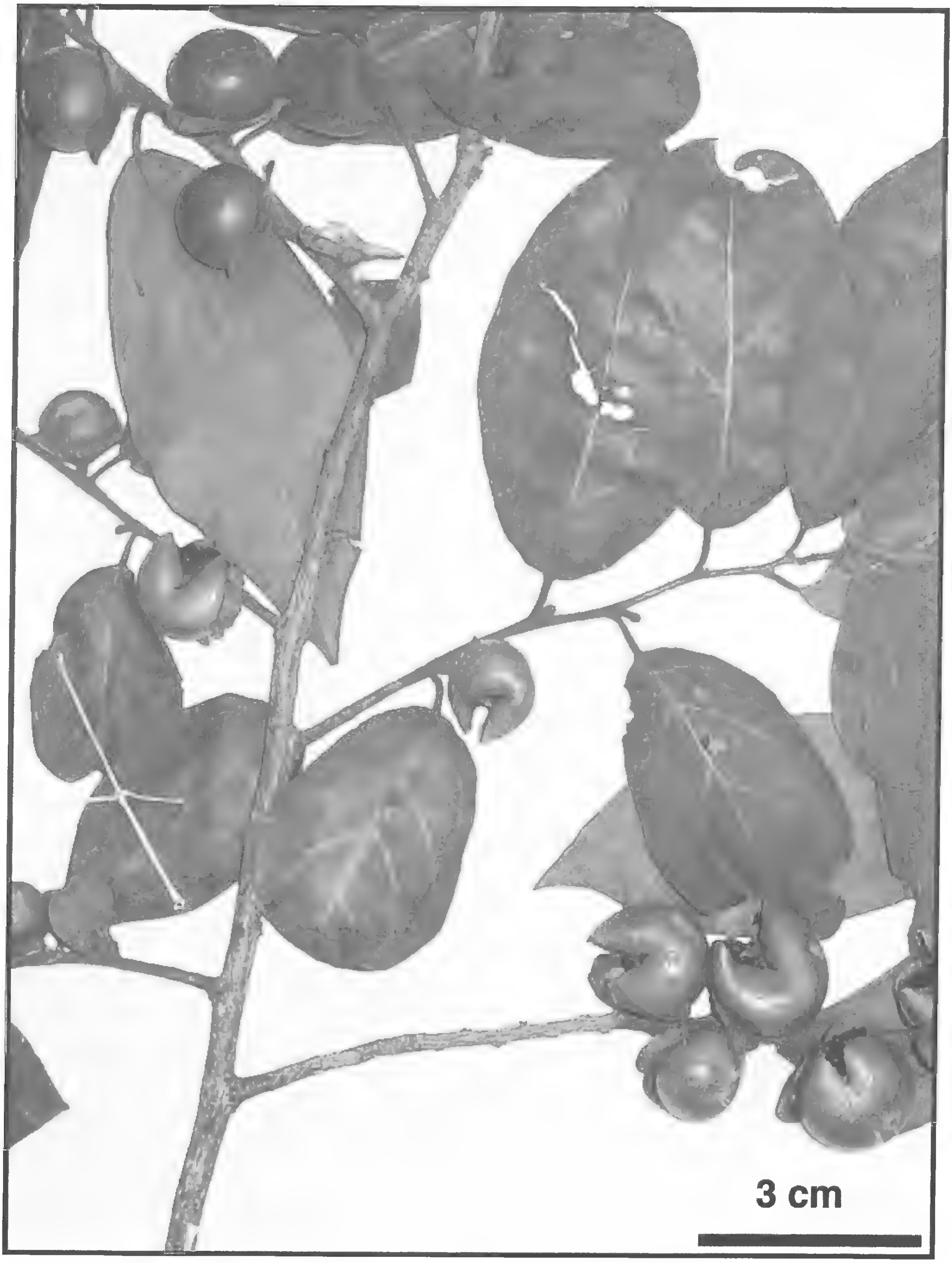

Fig. 46. Diospyros yucatanensis subsp. yucatanensis from Lago Peten Itza, Guatemala (B. Wallnöfer & F.M. Tut-Tesucun 5941, MO).

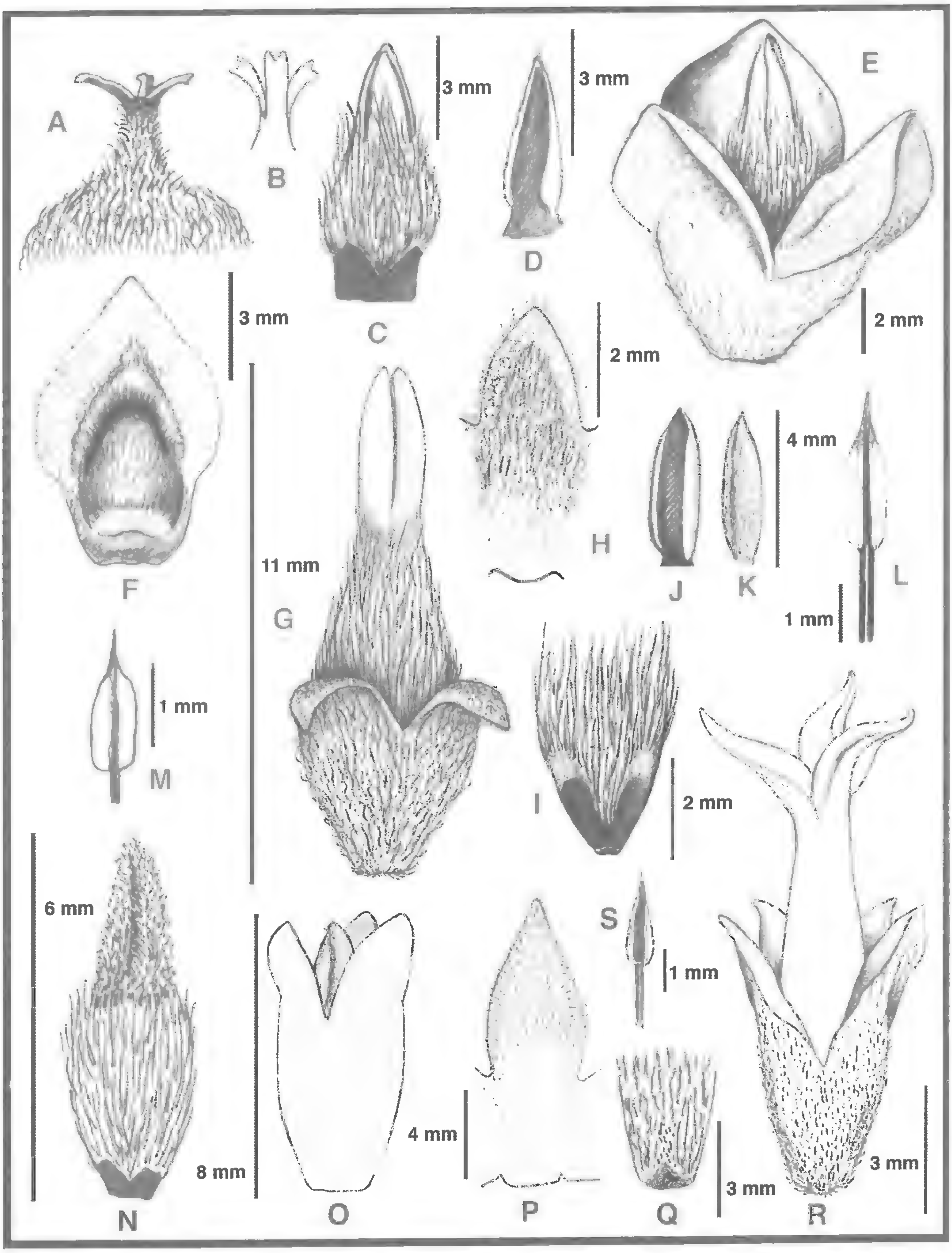

Fig. 47. *Diospyros yucatanensis* Lundell. A–F. subsp. *yucatanensis* from Tikal N.P. (*C.L. Lundell 16257*, IJ). A. Pistil. B. Diagram of styles and stigmas. C. Female corolla. D. Female corolla lobe. E. Female flower. F. Adaxial surface of female flowering calyx. G–L. subsp. *yucatanensis* from San Isidro, Tabasco, Mexico (*E. Matuda 3378*, NA). G. Male flower. H. Adaxial surface of male flowering calyx. I. Male corolla tube. J. Male corolla lobe (adaxial side). K. Male corolla lobe (abaxial side). L. Stamen. M–O. subsp. *yucatanensis* from Río Dulce, Izabal, Guatemala (*Steyermark 39427*, F). M. Stamen. N. Male corolla. O. Male flower. P–S. subsp. *spectabilis* from Quintana Roo, Mexico (*C. Gallardo et al. 2220*, MO). P. Adaxial surface of male flowering calyx. Q. Male corolla tube. R. Male flower. S. Stamen.

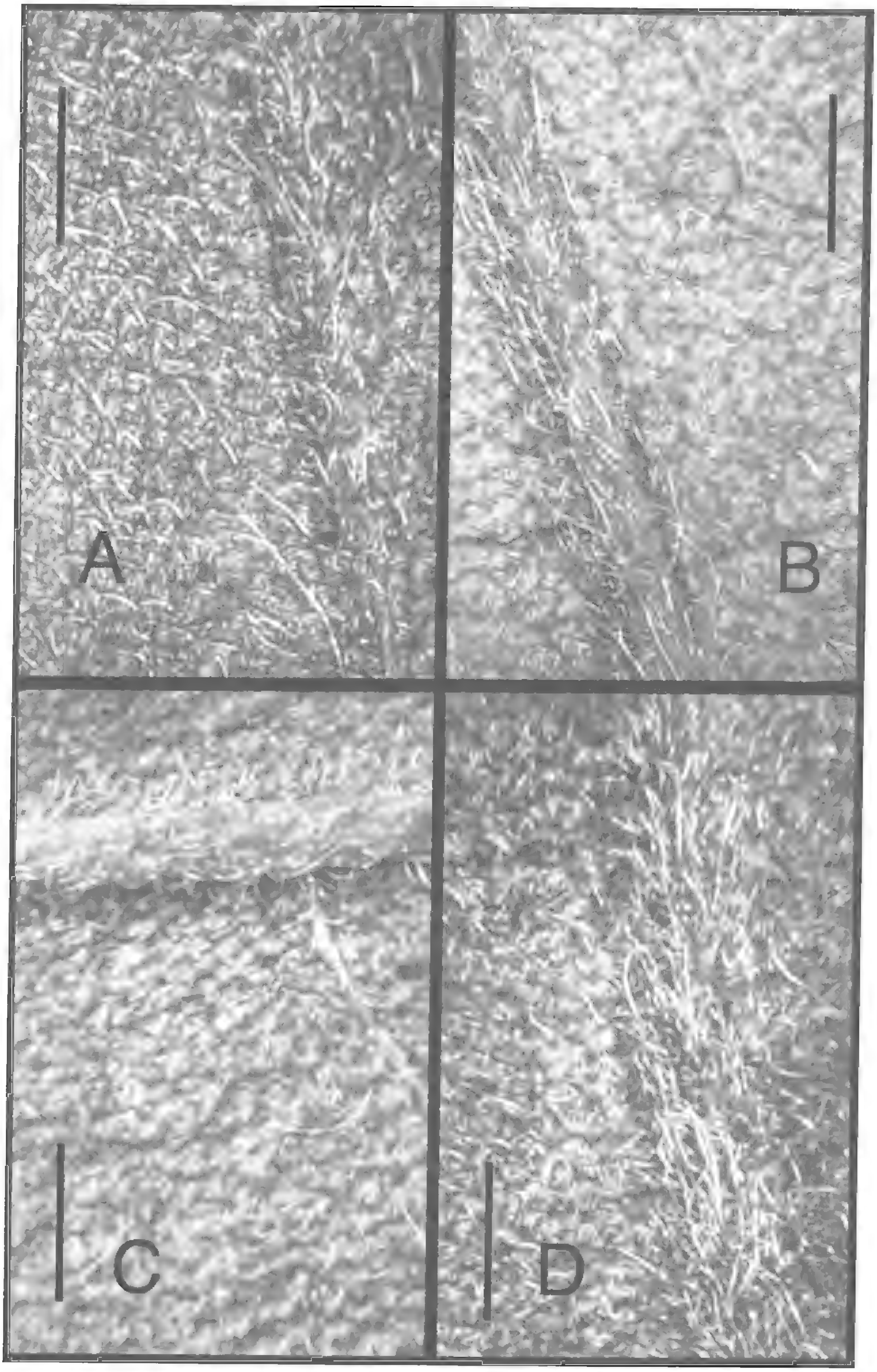

Fig. 48. Abaxial leaf vestiture, including midrib, of *D. yucatanensis* (scale = 1 mm). **A.** subsp. *spectabilis* (*J.D. Dwyer 12747*). **B.** subsp. *spectabilis* (*Schultz 1530,* UCR). **C.** subsp. *yucatanensis* (*Cabrera 14830,* MO). **D.** subsp. *yucatanensis* (*C.L. Lundell 6807,* ARIZ).

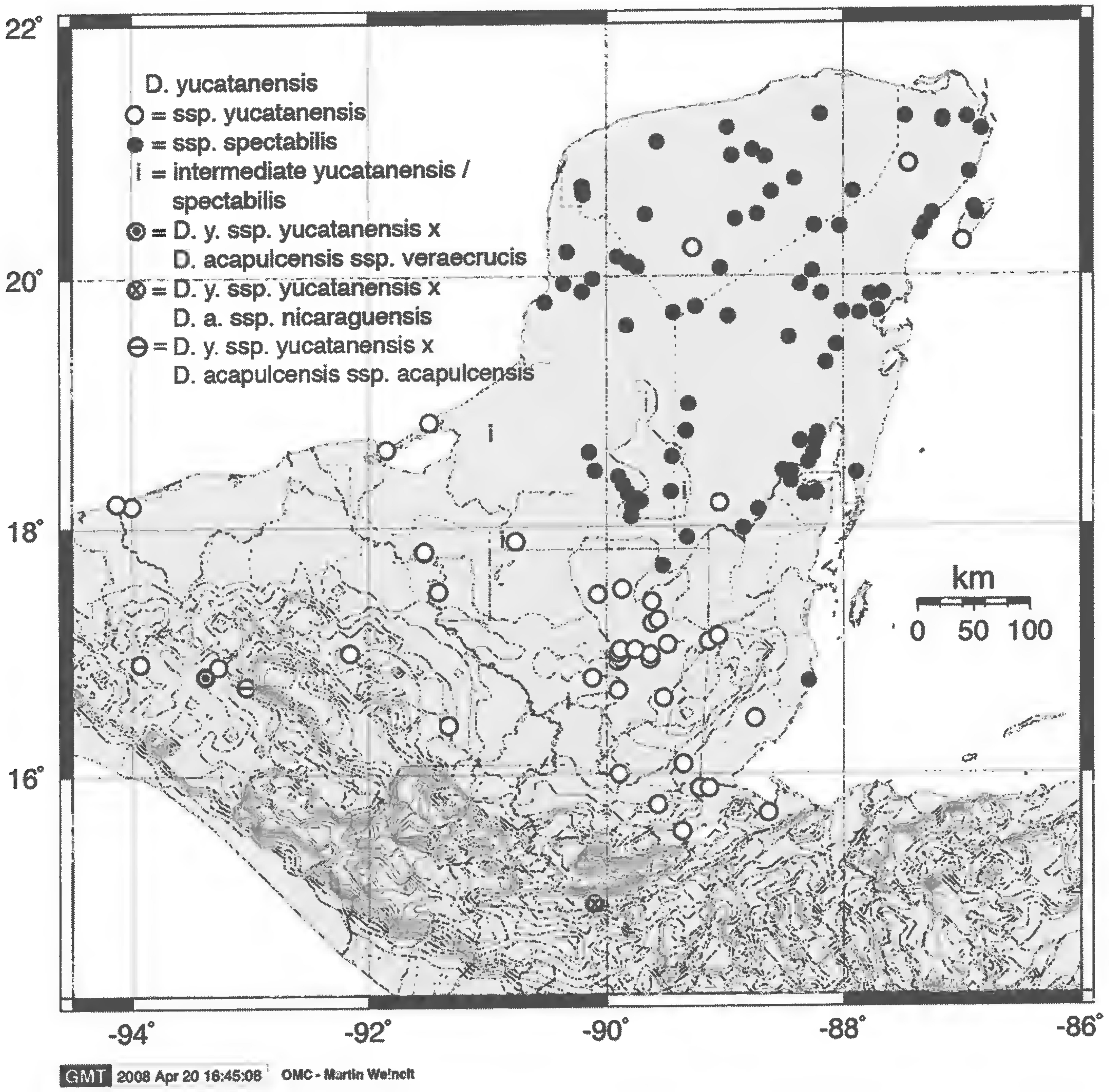
D. yucatanensis
○ = ssp. yucatanensis
● = ssp. spectabilis
i = intermediate yucatanensis / spectabilis
◉ = D. y. ssp. yucatanensis x D. acapulcensis ssp. veraecrucis
⊗ = D. y. ssp. yucatanensis x D. a. ssp. nicaraguensis
⊖ = D. y. ssp. yucatanensis x D. acapulcensis ssp. acapulcensis
22°
20°
18°
16°
-94°
-92°
-90°
-88°
-86°
km
0 50 100
GMT 2008 Apr 20 16:45:08 OMC - Martin Weinelt

Fig. 49. Distribution of *Diospyros yucatanensis.*

vestiture tends to be deciduous in both, though the vestiture of this taxon seems to be even less persistent than in the nominate subspecies.

Representative specimens. **BELIZE. Corozal:** 5 km NW of Chan Chen, 10 m, 16 Nov 1989, *M.J. Balick 2189* (BRH). **Orange Walk:** from mi 50, Northern Hwy. to new river toll bridge, 7 Jun 1974, *J.D. Dwyer 12747* (UMO, WIS, IJ, BRH, MO). **Stan Creek:** All Pines, 0 m, 12 May 1976, *G.R. Proctor 36205, 36207* (IJ). **GUATEMALA. Peten:** P.N. Río Azul, 0.5 km antes de llegar al Cedro Bosque, 20 Feb 2000, *M. Peña-Chocarro et al. 859* (BM); Dos Lagunas, 9 km E of village, 25 Nov 1960, *E. Contreras 1651* (IJ, F). **MEXICO. Campeche. Mpio. Calakmul:** central chiclera Buenfil (Calakmul), 24 Feb 1994, *J.M. Kantún 305* (UCAM). **Mpio. Campeche:** 1 km S de Samulá, 40 m, 1 May 2003, *C. Gutiérrez B. 7761* (UCAM). **Mpio. Escárcega:** desv. carr. Escárcega a Villahermosa, rumbo a Pital, 5 m, 29 Jan 1986, *C. Chan 6102* (CIQR). **Mpio. Hecelchacán:** carr. 5 km E de Cumpich con dirección a Bolonchén de Rejón, 3 Feb 2002, *G.G. Cabrera M. 12* (UCAM). **Mpio. Hopelchén:** Rancho El Carmen, near Xpanzil, 33–35 km S of Xmaben, 200 m, 13 Mar 1990, *A.C. Sanders et al. 9752* (SD, UCR). **Mpio. Tenaba:** entre San Pedro y Santa Rita, 28 Oct 1997, *P. Zamora C. & H. Uc C. 5890* (UCAM). **Quintana Roo. Mpio. Benito Juarez:** Cancun, 25 Feb 2005, *H. Kennedy & F. Ganders 5944* (UCR). **Mpio. Cozumel:** Isla Cozumel, 1 km NW del Faro de la Punta Celerain, 22 Nov 1985, *E. Cabrera et al. 9804* (MO). **Mpio. Felipe Carrillo Puerto:** 7 km E of Carrillo Puerto, 2 Nov 1984, *D. Neill et al. 5766* (MO). **Mpio. Lazaro Cardenas:** Yalahau Region, El Eden Reserve, ca. 30 mi NW of Cancún, 6 m, 26 Jun 2000, *G.P. Schultz et al. 1513* (MO, UCR), and about the same location 12 Jul 2000, *G.P. Schultz et al. 1530* (UCR). **Mpio. Othon P. Blanco:** 500 m S del Cenote en Bacalar, 15 May 1999, *R. Durán et al. 3271A* (MO). **Mpio. Solidaridad:** X'cacel a X'cacelito, ca. 13 km N de Tulum, 14

Jun 1998, *C. Gallardo et al. 2220* (MO). **YUCATAN. Mpio. Chemax:** 3 km W de Chemax, 16 Jul 1985, *E. & H. Cabrera 8868* (MO). **Mpio. Conkal:** camino Conkal a Yaxkukul. 5 m, 4 Nov 1997, *F. Tun, J.A. González-Iturbe 335* (SEL). **Mpio. Halacho:** Rancho El Naranjo, 12 m, 8 Sep 1988, *L.M. Ortega T. & E. Mena P. 787* (UCR). **Mpio Maxcanú:** Chunchucmil, 5 km a la redonda, 11m, 4 Aug 1986, *C. Chan 6864* (CIQR). **Mpio. Muna:** km 10 carr. Muna a Opichén, 50 m, 24 Sep 1984, *C. Chan 3991* (UC). **Mpio Oxkutzcab:** zona arq. de Sayil, 25 Dec 1985, *E. & H, Cabrera 10368* (CIQR, MO). **Mpio. Tekax:** Tekax, 18 Nov 1992, *F. May 775* (CIQR). **Mpio. Tixcacalcupul:** S de Xchak Hua, 13 Nov 1991, *M. Méndez et al. 398* (MO). **Mpio. Tizimín:** 6 km W de Tizimín rumbo a Sucilá, 22 Sep 1996, *R. Durán et al. 2619* (MO). **Mpio. Tunkas:** carr. rumbo Quintana Roo pueblo, 23 m, 19 Jan 1982, *E. Ucan et al. 1840* (NO). **Mpio. Tzucacab:** hills above Tzucacab, 16 Feb 1983, *D.A. White 271* (NO, JBSD). **Mpio. Valladolid:** Xuilub, 22 m, 24 Jun 1989, *M.C. Sanchez 342* (UAGC). **Mpio. Yaxcaba:** Tixcacaltuyub, 24 m, 29 Sep 1981, *C. Vargas & P. Sima 540* (NO); S.E. Kancabconot [Kancabdzonot], [27 m], May 1917, G.F. Gaumer 23862 (C, MO).

4b. **Diospyros yucatanensis** Lundell subsp. **yucatanensis** (**Figs. 46, 47a–o, 48c–d**).

Trees or shrubs, 3–15(–28) m tall; **trunk** up to 45 cm in diameter; **stems** usually glabrous, vestiture sometimes persisting into the 2nd year, the young stems glabrate to densely orangish to reddish-brown tomentose or wavy-hairy, sometimes with some straight ascending hairs, clavate glandular hairs sometimes present, deciduous, leaving the dark reddish-brown epidermis viscid and shiny. **Petioles** (3.5–)4–6.5(–8) mm long, ± rugose, golden or reddish-brown to very dark brown, viscid or glaucous, densely ascending pubescent below, densely short wavy-hairy above. **Lamina** oblong ovate to oblanceolate, sometimes elliptic to obovate, rarely lanceolate, (65–)70–106(–117) mm long, (20–)25–41(–47) mm wide, the length to width ratio (1.8–)2.2–3(–3.4) **:** 1, lamina at 0.75 length usually 19–30 mm wide, yellow-green in life (Lundell 1937), *base* rounded to the petiole or abruptly short-decurrent on the petiole, *margins* slightly revolute, *apex* acuminate or acute, sometimes rounded; **lower lamina surface** densely bright orange-red to tawny tomentulose, the hairs sometimes deciduous, the hair bases often swollen, the epidermis reddish-brown to gray, the stomatal apparatus dense, usually opaque and conspicuous; **upper lamina surface** reddish wavy-hairy, the epidermis sometimes crystal-papillose. **Venation** brochidodromous to arcolanguid; **midrib** densely bright reddish-brown tomentulose, with some longer, straight, subappressed hairs; **lateral veins** mostly prominent below, often bright reddish-brown velutinous, flush to finely raised above; **3° veins** ± raised below and obscured by the vestiture, slightly impressed or obscure. **Male inflorescences** 1–5-flowered cymes, tomentulose to wavy-hairy, the epidermis viscid, dark brown; **peduncles** 2–5 mm long; **pedicels** 1–3 mm long, bracts linear lanceolate, 1–3 mm long. **Male flowering calyx** densely golden to reddish tomentulose to short wavy-hairy outside, with some longer hairs, *tube* (3–)4.5–5.5 mm long, 4.5–5.5 mm wide, the upper 1/2 sericeous, lower 1/2 glabrous, *lobes* oblong-ovate to triangular, 3.5 mm long, 2.8–3.5 mm wide, subacute to barely acuminate, sericeous inside with a somewhat narrow tomentulose intramarginal band; **male corolla tube** (6.5–)9–10 mm long, 3–4 mm wide, sericeous except for 3 shield-shaped glabrous basal regions, 0.5–1.5 mm long, and some very minute wavy hairs just distal to these; **male corolla lobes** oblong-ovate, 3–5 mm long, 1.5–2.3 mm wide, reddish to brownish sericeous outside. **Stamens** 12–14; **filaments** adnate ± at the base of the corolla, a few stamens sometimes inserted on the receptacle, sometimes geminate, (1.5–)2–3.5 mm long; **anthers** lanceolate to ovate or oblong-ovate, 3–4.5 mm long, sometimes rostrate or cuspidate, apex thickened or granular. **Female inflorescences** 1–3 mm long, bracts deciduous (not seen by us), reported by Lundell (1937) to be oblanceolate and 3mm long. **Female flowering calyx** densely hairy, *tube* 2.5 mm long, 5 mm wide, sericeous except near the base where glabrous, *lobes* subacute to obtuse, 6 mm long, 5.5 mm wide, slightly rounded or tapering to a blunt point, sericeous inside with a wide tomentulose intramarginal band; **corolla tube** 3 mm long, 2.5 mm wide, the upper 2/3 reddish sericeous outside, lower 1/3 with 3 overlapping shield-shaped glabrous regions; **corolla lobes** ovate, 4 mm long, 3 mm wide; **ovary** ovoid, reddish sericeous; **styles** 3, spreading; **stigmas** bifid; **staminodes** 3, adnate to the corolla tube near the base, anther-like. **Fruiting pedicels** 2–6(–8) mm long, densely hairy. **Fruiting calyx tube** (3–)3.5–5.5(–7) mm long, sericeous except near the base, *lobes* widely oblong, 3–6(–8) mm long, (7–)9–12(–13) mm wide, rounded or obtusely tapered to a blunt point, spreading, sericeous except near the base, the hairs of the intramarginal band sparser than in the flowering calyx; epidermis puncticulate. **Fruit** globose, immature fruit sparsely tawny to reddish-brown hairy, mature fruit ± glabrous, but densely hairy near the apex.

The two collections Lundell used to describe male flowers were based on collections from Yucatan by Gaumer; one from Kancabdzonot, the other without a specific locality. The specimen from Kancabdzonot is representative of *D. y.* subsp. *spectabilis*, while the collection lacking a precise locality is inadequate for determination to the subspecific level. The nominate subspecies of *D. yucatanensis* has a more southern distribution than *D. y.* subsp. *spectabilis* (Fig. 49). It occurs in the eastern extreme of coastal Veracruz, Tabasco, parts of Campeche, the northern highlands of Chiapas, Mexico, the mountainous parts of Belize, and through a large part of northern Guatemala. We have seen three collections that are biogeographically difficult to explain at this time, two from northern Quintana Roo, including one from the southern part of Cozumel, and another from near Popolna, and a collection from near Sayil in the state of Yucatan. It grows on thin or rocky soils in evergreen forest, deciduous forests, and secondary forest derived from these vegetation types, usually between sea level and 360 m, but at elevations up to 700 m in Belize, and 1400 m in Chiapas, Mexico. It is sometimes associated with cliffs. The distribution of this taxon apparently overlaps with both *D. acapulcensis* subsp. *veraecrucis* and *D. a.* subsp. *acapulcensis* in northwest Chiapas. We have seen single collections of hybrid material between *D. yucatanensis* and each of these subspecies from this region.

Representative specimens. **BELIZE. Cayo:** brecha al W del "Rancho Indio Suizo," 8 mar 1985, *E. Cabrera et al. 7719* (CIQR). **Toledo:** ca. 6.5 mi W of Medina Bank, 800–1200 ft, 23–27 Apr 1976, *G.R. Proctor 35991* (MO); Mountain Pine Ridge, San Agustin, Jul–Aug 1936, *C.L. Lundell 6807* (ARIZ). **GUATEMALA. Baja Verapaz:** El Mago, 26 Oct 1968, *E. Contreras 8015* (XAL, F). **Izabal:** Bay of Santo Tomás, 0–2 m, 13 Apr 1940, *J.A. Steyermark 39366* (F); Puerto Mendez, bordering Sarstun River, 5 km, 9 Oct 1969, *E. Contreras 9293* (MO); Río Dulce, N side, between Livingston and 6 mi up river, 1–25 m, 14 Apr 1940, *J.A. Steyermark 39427* (F). **Peten:** Lake Petén, 3 May 1933, *C.L. Lundell 3194* (F); Umgebung des Westufers des Lago Peten Itza, La Providencia" (= "La Trinidad"), 170 m, 17 Aug 1993, *B. Wallnöfer & F.M. Tut-Tesucun 5941* (MO); San Miguel, 14 Dec 1967, *E. Contreras 7316* (F, IJ); Tikal N.P., top of Temple Two, 8 Jul 1959, *C.L. Lundell 16257* (IJ, F). **MEXICO. Campeche. Mpio. Carmen:** cerca de la Est. del Carmen, del ICMyL, UNAM, ca. 9 km E de Cd. Carmen, 23 Nov 1987, *E. & H. Cabrera 14830* (MO, IEB); Colonia Nueva Coahuila, 10 m, 15 Jan 1982, *C. Chan 1118* (XAL). **Chiapas. Mpio. Las Margaritas:** W side of Laguna Miramar, 350 m, 11 Feb 1973, *D.E. Breedlove 33386* (CHAPA). **Mpio. Ocosingo:** 7 km E de El Carmen Pataté, 900 m, 10 Apr 1991, *E. Martínez S., C.H. Ramos & C. Eufrosio 24581* (XAL). **Mpio. Ocozocoautla:** Res. del Ocote, 380 m, 6 May 1983, *J.I. Calzada 10003* (XAL). **Mpio. Palenque:** La Montaña, desviación a Sn. Juan Bautista, 20 m, 5 Jul 1999, *C. Gutiérrez B. & J. Balam 6607* (UCAM). **Mpio. San Fernando:** between San Fernando and Moravillas, 840–940 m, 15 Feb 1987, *T.B. Croat & D.P. Hannon 65041* (MO). **Quintana Roo. Mpio. Cozumel:** parte S de la isla, 4 m, 27 Aug 1985, *C. Chan 5619* (CIQR). **Mpio. Lazaro Cardenas:** 2 km E de Popolna, 12 Nov 1980, *E. Cabrera & L. Cortez 256* (MO, CIQR). **Mpio. Solidaridad:** 12 km S del Ejido Laguna OM, 7 Aug 1980, *O. Téllez & E. Cabrera 3058* (MO). **Tabasco. Mpio. Balancan:** Balancan, 9 Dec 1975, *A. Novelo et al. 186* (K, MO, ARIZ, XAL); San Isidro, 7–11 Jun 1939, *E. Matuda 3378* (K, NA, CAS, MO). **Mpio. Emiliano Zapata:** 9 km SE de Emiliano Zapata, 20 Nov 1986, *E. & H. Cabrera 12471* (MO). **Mpio. Huimanguillo:** Cuauhtemotzín, 0 m, 2 Dec 1983, *F. Ventura A. 20848* (MO, XAL, IEB). **Mpio Tenosique:** Tenosique, 14–16 Jun 1939, *E. Matuda 3401* (K, NA, MO, CAS). **Veracruz. Mpio. Pajapan:** Laguna del Ostión, 0–5 m, 28 Mar 1980, *L. Gutierrez 91* (XALU). **Yucatan. Mpio. Oxkutzcab:** 4 km W de Sayil, 20 m, 25 Oct 1984, *A. Espejo et al. 1235* (CHAPA).

Diospyros yucatanensis Lundell var. **longipedicellata** Lundell, Contr. Univ. Michigan Herb. 7:45. 1942.

Type: MEXICO. Yucatan: Chichen Itzá off Kaua road in advanced deciduous forest [as on label], "along Kaua road, east of Chichen Itzá, in advanced deciduous forest" [protologue], [20°40'W, 88°33'N, 29 m], Jun 11 [protologue], Jun–Jul [specimen], 1938, *C.L. Lundell & Amelia A. Lundell 7509* (holotype: MICH; isotypes: WTU!, LL, digital image!).

Lundell described this taxon based on its long male flowering pedicels. The small amount of material we have seen shows similarities in leaf and inflorescence characters to both subspecies, while the male flowering peduncles (e.g., *C. Chan 5110*) seem rather long for each subspecies. We suspect this name is synonymous with *D. y.* subsp. *spectabilis*, but would like to see material with fruit from Chichen Itzá before taking a position on the status of this taxon.

Additional material examined: **Mpio. Izamal:** K'axek, rumbo a Tunkas, 20 m, 17 Apr 1985, *E. Ucan et al. 3812* (CIQR). **Mpio. Tinum:** Tinum, alrededor del cenote Xholak, en Chichen Itzá, 25 m, 25 May 1985, *C. Chan 5110* (CIQR); Chichen Itzá, in second growth, *C.L. Lundell & A.A. Lundell 7434* (CAS, WIS).

MULTIVARIATE ANALYSES RESULTS AND DISCUSSION

A total of 23 leaf and fruiting inflorescence characters were used in the analyses (Table 1). From these, four character subsets were derived from the matrix, with lamina length and lamina width treated as priority characters, and $R < 0.7$ and $R < 0.8$ used as exclusion values (Table 2). A summary of the resulting biplots

Table 2. Subsets of characters used in principal component analyses.

Subset 1. Lamina length priority, R < 0.7	**Subset 3. Lamina width priority, R < 0.7**
lamina length	lamina width
lamina length : lamina width	lamina length : lamina width
lamina width at 0.75	petiole length
lamina width at 0.25 : lamina width	lamina width at 0.25 : lamina width
lamina width at 0.75 : lamina width	lamina width at 0.75 : lamina width
lamina length : distance between four centermost veins	lamina length : distance between four centermost veins
pedicel length	pedicel length
sepal width	sepal width
sepal length	sepal length
calyx tube length	calyx tube length

Subset 2. Lamina length priority, R < 0.8	**Subset 4. Lamina width priority, R < 0.8**
lamina length	lamina width
lamina length : lamina width	lamina length : lamina width
petiole length	petiole length
lamina width at 0.25	lamina length : lamina width at 0.25
lamina width at 0.75	lamina width at 0.25 : lamina width at 0.75
lamina length : lamina width at 0.25	lamina width at 0.25 : lamina width
lamina width at 0.25 : lamina width at 0.75	lamina width at 0.75 : lamina width
lamina width at 0.25 : lamina width	lamina length : distance between four centermost veins
lamina width at 0.75 : lamina width	pedicel length
lamina length : distance between four centermost veins	sepal width
pedicel length	sepal length
sepal width	calyx tube length
sepal length	sepal width : calyx tube length
calyx tube length	
sepal width : calyx tube length	

for PCA of the subsets is provided in Table 3. A biplot for subset 2 (leaf length given priority, R < 0.8) is presented for demonstration purposes (Fig. 50). Overall, biplots supported the four species groups identified by conventional taxonomic methods. In biplots of PC1 vs. PC2, *Diospyros acapulcensis*, *D. yucatanensis* and *D. aequoris* each tended to form distinct clusters that overlapped to varying degrees in the area where the PC-axes converged. *Diospyros salicifolia* collections typically formed a subcluster in this region of overlap. *Diospyros intricata* formed a cluster most closely associated with *D. aequoris*, but effectively separated from other taxa along the PC2-axis. The putative interspecific hybrid usually grouped with collections of *D. acapulcensis*. Separation of the taxa into groups along the PC3-axis was usually poor, although *D. intricata* separated completely from the other taxa in subset 4.

The intermediate position of *D. salicifolia* in the biplots suggests a hybrid origin for *D. salicifolia*. If this is the case, then based on geography, the likely parent taxa are *D. aequoris*, perhaps a form similar to subsp. *chutlensis* of western Guerrero, and the nominate subspecies of *D. acapulcensis*. However, we have no direct evidence that hybridization occurs between these taxa. Inflorescence size characters are clearly more similar to *D. aequoris* subsp. *chutlensis* than the nominate form of *D. acapulcensis*. However, leaf characters of *D. salicifolia*, such as lamina size, shape, and venation, usually group clearly with one putative parent or the other, and often represent the extreme measurements for that character among the three taxa. In general, specimens of *D. salicifolia* are rather consistent with respect to qualitative and quantitative characters. At any rate, it seems most unlikely that specimens of *D. salicifolia* represent F1 hybrids of the possible parent taxa, since neither of these species occurs with *D. salicifolia*, nor are the parent taxa currently believed to be

TABLE 3. Summary of biplots resulting from PCA of subsets 1–4.

	Axes	Separation
Subset 1.		
	PC1	*D. acapulcensis* is separated from *D. yucatanensis* and *D. aequoris* with minor overlap.
	PC2	*D. intricata* is separated from all other taxa. *D. aequoris* is separated from *D. yucatanensis* with slight overlap, and is tending to separate from *D. acapulcensis*.
Subset 2.	PC1	*D. yucatanensis* is nearly completely separated from *D. acapulcensis*. *Diospyros aequoris* is separated from *D. acapulcensis* with small amounts of overlap.
	PC2	*D. aequoris* is separated from *D. acapulcensis* with small amounts of overlap, and separated from *D. yucatanensis* with minor overlap. *D. intricata* is effectively separated from all other taxa.
Subset 3.		
	PC1	*D. acapulcensis* and *D. yucatanensis* are separated with minor overlap.
	PC2	*D. aequoris* is separated from *D. yucatanensis* and *D. acapulcensis*, but with some overlap. *D. intricata* is effectively separated from all other taxa.
Subset 4.		
	PC1	*D. acapulcensis* and *D. yucatanensis* are nearly completely separated.
	PC2	*D. aequoris* separates from *D. yucatanensis*, but with some overlap, and tends to separate from *D. acapulcensis*, but with considerable overlap.
	PC3	*D. intricata* separates completely from other taxa.

sympatric anywhere. The possibility of a recent hybrid origin for *D. salicifolia* could not be addressed sufficiently by the current study. It would be worthwhile to pursue genetic evidence for or against this hypothesis using DNA microsatellite markers, ex situ cross-fertilization experiments, or by looking for possible differences in chromosome number.

The *D. intricata* cluster was most associated with the *D. aequoris* cluster. *Diospyros intricata* is generally thought to be endemic to the Cape Region of Baja California Sur and Isla Cerralvo in the Gulf of California (We have not yet been able to verify material recently reported from an isolated upland locality on Isla Tiburón [Wilder et al. 2008]). Consequently, it is separated from all other taxa of the *salicifolia* complex by the Sea of Cortez. The range of *D. intricata* is more closely approached by *D. aequoris* (in Sinaloa) than *D. acapulcensis* (in Jalisco). We have not seen any collections that appear to be intermediate between *D. aequoris* and *D. intricata*.

The characters with the highest loadings for the rotated principal components (RPC) are reported in Table 4. High loadings in the rotated factor patterns were most often seen in inflorescence size variables, although leaf size characters had the highest loadings for subset 2. While inflorescences size characters proved useful in explaining the variation in the data set, they were not much used during conventional taxon delimitation (perhaps some in the case of *D. yucatanensis*). Leaf size and shape characters were useful in explaining variation in the data as well, while inflorescence shape characters were relatively less important. Conversely, some characters that were important during conventional taxon delimitation (i.e., hair base morphology, leaf thickness, prominence of venation, etc.) were not considered during PCA. It should be remembered that interpretation of the rotated factor patterns does have a subjective element. Still, it appears significant that PCA found groups consistent with those found during conventional taxonomic procedures, even though the RPC highlighted a somewhat different set of characters. It thus provides a somewhat independent confirmation of the existence of the identified groups.

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TABLE 4. Characters with highest loadings for RPC of subsets 1–4.

	RPC 1	RPC2	RPC3	RPC4	RPC5
Subset 1.	pdL SL	LL LW3/4	SW CL	LL:LW	
Subset 2.	LL ptL LW1/4 LW3/4	LW1/4:LW3/4 LW1/4:LW LW3/4:LW	pdL SL SW:CL	LL:LW1/4	SW CL
Subset 3.	pdL SL	SW CL	LW ptL	LL:LW LL:V	
Subset 4.	pdL SL SW:CL	LW1/4:LW3/4 LW1/4:LW LW3/4:LW	LL:LW LL:LW1/4	SW CL	LW ptL

providing Latin diagnoses, Ed Plummer for technical support, Jose Aguilar Patiño (UAS), Francisco Santana-Michel (ZEA), Antonio Machuca (CREG), Teresa B. Salvato (UCR), C. Conrado, Jeffrey Ross-Ibarra, and Randy Richmeier for field assistance. We are grateful to Jeffrey Ross-Ibarra for his assistance with the statistical investigations. Much appreciated specimen loans and images were provided by: AAU, ARIZ, B, BH, BM, BRH, C, CAS, CHAPA, CIIDIR, CIMI, CIQR, DES, E, EBUM, F, FLAS, FR, GB, HUAA, IEB, IJ, ILL, JBSD, K, LSU, MAD, MSCH, MO, MOU, NA, NLU, NO, P, SD, SEL, TEFH, TEX, UAGC, UC, UCAM, UCR, UCSB, UMO, US, USF, UTEP, XAL, XALU, VT, WIS, WTU, ZEA.

APPENDIX 1

Representative subspecific intermediates and interspecific hybrid specimens:

Diospyros acapulcensis subsp. **guanacastensis** interm. with **D. acapulcensis** subsp. **rivensis. COSTA RICA. Guanacaste:** Cerro El Hacha, P.N. Guanacaste, 1100 m, 15 Sep 1991, *R.E. Espinoza 120* (MO, BM). **San José:** Río Uruca, near Santa Ana, 900 m, 7 Jan 1970, *W.C. Burger & R.L. Liesner 7180* (MO). **Puntarenas:** Nicoya Peninsula, Curú, 2–75 m, 31 Aug 1995, *A.C. Sanders et al. 17728* (UCR); Cantón de Acosta, San Ignacio, Río Candelaria, 700 m, 10 Aug 1993, *J.F. Morales 1576* (MO).

Diospyros acapulcensis subsp. **rivensis** interm. with **D. acapulcensis** subsp. **nicaraguensis. NICARAGUA. Leon:** Sector NE de la Isla de Momotombito, 200 m, 21 Oct 1979, *M. Araquistain 371* (MO); Sector W de la Isla Momotombito, 150–200 m, 27 Jan 1980, *M, Araquistain & P. Moreno 1061* (MO). **Managua:** Campus of Escuela Americana, 200 m, 20 Oct 1976, *D. Neill 1088* (MO).

Diospyros acapulcensis subsp. **pedromorenoi** interm. with subsp. **nicaraguensis. Chontales:** Hacienda Corpus, ca. 100 m, 5 Sep 1982, *W.D. Stevens 21802* (MO); **Estelí:** Llano El Pozo, 18 km E de Estelí, 1260–1300 m, 23 May 1983, *P. Moreno 21380* (MO). **Leon:** Volcán Momotombo, 200 m, 29 Jan 1980, *M. Araquistain & P. Moreno 1082* (MO). **Matagalpa:** Valle "Pueblo Viejo," 500 m, 2 Feb 1984, *P. Moreno 22958* (MO).

Diospyros acapulcensis subsp. **rivensis** interm. with **D. acapulcensis** subsp. **veraecrucis. HONDURAS. Valle:** Amapala, Isla de la Tigre, falda W del cerro volcanico, 0–400 m, 4 Apr 1981, *C. Nelson & H. Martínez C. 7743* (MO, TEFH);

Diospyros aequoris subsp. **balsensis** interm. with subsp. **martineziana. MÉXICO. Michoacan:** Mpio. Huetamo: a 8 km al NW de San Jeronimo, carretera Huetamo-Churumuco, 370 m, 20 Mar 1981, *J.C. Soto N. et al. 2687* (MO, XAL, ILL).

Diospyros aequoris subsp. **rekoi** interm. with subsp. **tehuantepecensis. MEXICO. Oaxaca:** Mpio. Salinas Cruz: El Coyol, 2 km al W de Salina Cruz, 17 Mar 1981, *T.P. Ramamoorthy et al. 2014* (IEB); Mpio. Santiago Astata: Playa La Colorada, 1.8 km al W, 40 m, 30 Jul 2000, *Silvia Salas M. 3163* (IEB); Mpio. Tehuantepec: Cerro Lieza, 2 km NW de Tehuantepec, 1 Nov 1996, *Cipriano Martínes R. 757* (MO).

Diospyros yucatanensis subsp. **spectabilis** interm. **Diospyros yucatanensis** subsp. **yucatanensis. GUATEMALA. Peten:** Río Pasion, Laguna San Juan Acul, 11 Feb 1964, *C.L. Lundell 17946* (F). **MEXICO. Campeche:** Mpio. Candelaria: entre Candelaria y Venustiano Carranza, 9 Aug 1996, *P. Zamora C. & D. Méndez D. 5348* (UCAM); Mpio. Escársega: 5 km al N de Escársega, 8 m, 16 Nov 2003, *C. Gutiérrez B. 8036* (UCAM); Mpio. Hopelchén: Xcochkax, 30 m, 9 Mar 1987, *J.N. Labat 1918* (IEB).

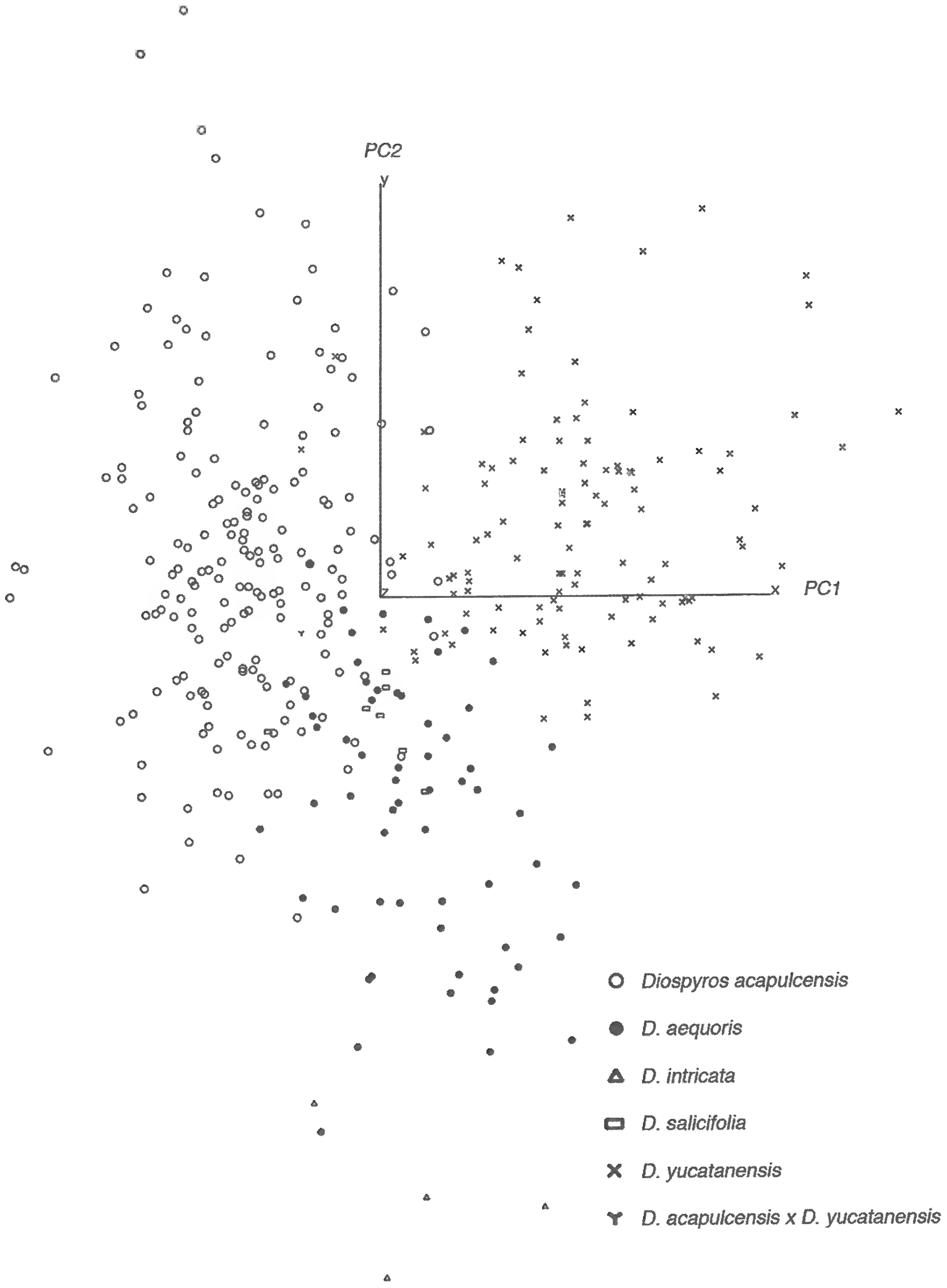

Fig. 50. Biplot of PC1 vs. PC2 for subset 2 (leaf length given priority, $R < 0.8$).

Diospyros yucatanensis subsp. **yucatanensis × D. acapulcensis** subsp. **acapulcensis. Mpio. Chiapa de Corzo:** Río Grijalva, 10 km W of Chiapa de Corzo, 500 m, 16 May 1972, *D.E. Breedlove 25167* (MO).

Diospyros yucatanensis subsp. **yucatanensis × D. acapulcensis** subsp. **veraecrucis. MEXICO. Chiapas:** Mpio. Ocozocoautla de Espinosa: 3 km N of Ocozocoautla along road to Mal Paso, 1 Feb 1973, *D.E. Breedlove 32870* (CHAPA).

Diospyros yucatanensis subsp. **yucatanensis × D. acapulcensis** subsp. **nicaraguensis. GUATEMALA. Baja Verapaz:** Opp. El Rancho, 2300 ft, 12 Jan 1908, *W.A. Kellerman 7990* (F), and same location, 2500 ft, 5 Jan 1908, *W.A. Kellerman 7640* (F [2 sheets]).

APPENDIX 2

Specimens examined of ***Diospyros* aff. *inconstans*: PANAMA. Darien:** El Real, 1–3 km S. of town, near sea level, 7 Jan 1975, *A. Gentry 13458* (MO, TEFH); El Real, 1 Mar 1972, *A. Gentry 4508* (MO); Río Tuira, vicinity of El Real, 14 Jun 1959, *W.L. Stern et al. 455* (MO); same location, 1 Jul 1959, *W.L. Stern et al. 763* (MO); El Real, near airport, 13 Jul 1971, *T.B. Croat & Porter 15467* (TEFH); El Real, Quebrada Trapiche, [without date], *J.A. Duke & N. Bristan 324* (MO).

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A TAXONOMIC REVISION OF *CRATAEGUS* SERIES *LACRIMATAE* (ROSACEAE)

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ABSTRACT

This paper reviews *Crataegus* ser. *Lacrimatae* (Rosaceae), the largest segregate of ser. *Flavae*, sens. auctt. Nearly 1500 specimens were examined for the study of this often abundant component of the southeastern United States flora. A detailed series description is given, together with differentiation from allied series. Twenty-two distinct and several subsidiary species are treated, broadly following species concepts established by Beadle, who had recognized 54 species. One of the species treated, **C. lancei,** is new to science. A key is provided to all taxa treated. All names used are typified, detailed species descriptions provided, 20 of the species are provided with line illustrations, mostly for the first time and the first ever distribution maps, 17 in all, are provided. Most, if not all, of the species of series *Lacrimatae* are more or less fire-resistant xeromorphs some of which are capable of surviving in the most xeric of North American *Crataegus* habitats. The series is marked by normally pendulous branching, often yellow to orange fruit, small leaves and a high degree of glandularity.

Key Words: *Crataegus*, ser. *Lacrimatae*, *C. lancei* sp. nov., Rosaceae, taxonomic review, southeastern United States, xeromorphy

RESUMEN

En este artículo se revisa *Crataegus* ser. *Lacrimatae* (Rosaceae), el segregado mayor de la ser. *Flavae*, sens. auctt. Se examinaron cerca de 1500 especimenes para el estudio de este componente, a menudo abundante, de la flora del sureste de los Estados Unidos. Se da una descripción detallada de la serie, junto con la diferenciación de las series parecidas. Se tratan veintidós especies distintas y varias subsidiarias, siguiendo en líneas generales el concepto de especie establecido por Beadle, que ha reconocido 54 especies. Una de las especies tratadas, **C. lancei,** es nueva para la ciencia. Se aporta una clave para todos los taxa tratados. Se tipifican todos los nombres usados, se aportan descripciones detalladas de las especies, ilustraciones de 20 de las especies, la mayoría por primera vez y los primeros mapas de distribución, 17 en total. La mayoría, si no todas, de las especies de la serie *Lacrimatae* son xeromórficas más o menos resistentes al fuego alguna de las cuales es capaz de sobrevivir en los hábitats de *Crataegus* más xéricos de Norteamérica. La serie se reconoce por su ramificación normalmente péndula, fruto a menudo de amarilla a naranja, hojas pequeñas y un alto grado de glandulosidad.

INTRODUCTION

This paper continues an ongoing revision of elements of *Crataegus*, mainly poorly or imperfectly known series, in the southeastern United States. The previous publications cover series *Aestivales*, *Parvifoliae*, *Pulcherrimae, Bracteatae* and *Triflorae,* and *Apricae* (Phipps (1988a, b), Phipps and Dvorsky (2006, 2007), Phipps, O'Kennon and Dvorsky (2006), Phipps, Lance and Dvorsky (2006)).

Series *Lacrimatae* is most similar to ser. *Apricae* but is part of what American authors during much of the last century have included in *Flavae*, a problem which is discussed in Phipps and Dvorsky (2007). The two series *Lacrimatae* and *Apricae* are differentiated as follows: whereas all but two dwarf species of ser. *Lacrimatae* have more or less pendulous terminal branches, at least at maturity, and all have distinctly zig-zag young twigs, 20 stamens and white to cream anthers, members of series *Apricae* lack conspicuously pendant branches, have unbent or only slightly bent nodes, most commonly 10 stamens and often have pink to purple anthers. In addition, ser. *Lacrimatae* species usually have less venous leaves, their veins spreading at a narrower angle. It would also appear to be the case that a good many members of ser. *Apricae* are less xeromorpic than any in ser. *Lacrimatae*. In herbaria confusion of smaller-leaved species of ser. *Lacrimatae* with *C. uniflora* (ser. *Parvifoliae*) is not uncommon, but more or less straight, non-pendulous twigs are definitive for ser. *Parvifoliae*. In addition, the number of styles and nutlets is usually greater and the calyx lobes are normally much larger and much more deeply dissected in the latter series. Also see discussion under ser. *Parvifoliae* (Phipps & Dvorsky 2006a).

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There are two rather well defined groups within ser. *Lacrimatae* which are here described as subseries. These differ primarily in leaf shape, size, and texture, in twig thickness, and in fruit size, shape, and color. The first subseries, *Tenues* (spp. 1–8a), consists of more slender plants, with shorter and finer thorns, generally smaller and thinner leaves, often smaller flowers, smaller fruit and generally thinner twigs. The second subseries, *Robustae* (spp. 9–22), consists of sturdier plants, with stouter and generally longer thorns, larger leaves, often larger flowers, usually larger fruit and generally thicker twigs. Many of the species of both these groups are densely white-hairy, typical xeromorphs, though a few are glabrous. Nearly all have yellow (sometimes red-cheeked) to orange or ruddy fruit.

No species names correctly attributable to ser. *Lacrimatae* appeared before 1900 when Beadle commenced his studies in this large group and Ashe described a few species. However, it is to Beadle that credit must be given for being the first to observe and comprehensively record their variation. Beadle eventually (1903) recognized 54 species in nine groups that might equate to subseries. Nearly all later floristic workers have shown a reluctance to get to grips with Beadle's demonstration of this large amount of variation, and drastically reduced Beadle's total of species without discussion, thus, none of these treatments represents a critical re-examination of the group. Murrill (1942), however, in a local study of Florida hawthorns, added several species which either seem to represent rare, local forms, or can be synonymized, and none of them is upheld here. W.W. Ashe also made quite numerous collections, particularly in North Carolina, but described relatively few taxa in this group, all of which are either synonymized here or untypifiable. In spite of the attention of these three authors, one of the species treated here, *C. lancei*, had escaped notice (or else perhaps equates to an untypifiable Ashe name), and is thus new to science.

In the view presented here, Beadle did name too many species, which often differ from one another by only slight differences in fruit shape or tomentum. However, the opposite extreme of attempting to lump all or most of the variation into a very few species, if done with an eye to objectivity rather than procrustean systematics, is a very difficult exercise. Nevertheless, that is what important floras of the region since Beadle's time have habitually done, for example, Tidestrom (1933), Radford et al. (1968) and Wunderlin and Hansen (2003), who typically used some or all of *C. flava* (Aiton 1789), *C. lacrimata* (Small, 1901), *C. floridana* (Sarg. 1902) and *C. michauxii* (Pers. 1806). These four species names will now be considered.

Crataegus flava has understandably found favor since it is a very old name and became the type of the long-established series *Flavae* (Loudon) Rehder. Nevertheless, careful examination of its type specimen shows it to be a particularly distinct member of series *Flavae* as previously delimited (Phipps 1988a). Indeed, it proves so different from the remaining *Flavae* that it is now transferred to ser. *Intricatae* (see discussion in Phipps & Dvorsky 2007). Faxon's illustration of *C. flava* (something like *C. condigna* Beadle or *C. colonica* Beadle is shown) in Sargent's Silva vol. IV, of 1890, was no doubt influential as the source of the misapplication of *C. flava* in a generic sense for ser. *Lacrimatae* species. Although Sargent (1902) later issued a corrected description and illustration of *C. flava* no attention appeared to be given to it. The 1902 correction is of a plant far more like true *C. flava* though it differs in stamen number. *Crataegus lacrimata*, on the other hand, is one of the most typical, yet distinct and easily recognized members of ser. *Lacrimatae* and it is difficult to see why its interpretation should be widened. In any case, there are earlier names available from the series. Sargent's 1902 account of *C. floridana* has no illustration and explains that the 1890 '*flava*' illustration should apply to it. This would appear to have resolved the confusion, at least from Sargent's perspective. However, unaccountably, it did not and instead it merely provided a rather imprecisely illustrated *C. floridana* for the ranks of later floristic accounts. *Crataegus floridana* correctly understood, was nonetheless another poor choice for one-to-few species accounts of the groups since while there is no question that it is a typical member of ser. *Lacrimatae*, it is not only a less clear-cut species than *C. lacrimata* but as many as 11 species accepted here all have earlier names, and therefore the name lacks appropriate priority if combined with any of them.

Particular problems surround the much used name *C. michauxii* which many floras, starting with Beadle (1903), have treated as a member of the southeastern United States flora, where it is routinely construed to be a member of ser. *Lacrimatae* (under different group names) more or less as understood here. Persoon's name *C. michauxii* was a new one for *C. glandulosa* of A. Michaux (1803), itself homonymous to *C. glandulosa* of Moench (1785) and of Georgi (1776) which are Eurasian. Persoon's protologue gives: "Habitat in Carol. Super."; "spinosis...stipulis, calycibus imaque fol. parte glandulosis, fol. subrotund. breviter lobatis subpubescentibus; fl. subsessilis," which is of little diagnostic help. Moreover, the name *C. michauxii* is rejected for use in this paper because the type specimen at P of Michaux's *C. glandulosa* is simply a piece from a vigorously growing extension shoot of an unidentifiable species. Any attempt to effect an accurate modern identification from such defective material seems impossible unless at some future date it were to be done by molecular methodology. One thus has to wonder about Beadle's rationale in resuscitating the name *C. michauxii* when his species concepts were narrow. Of course, Beadle's (op. cit.) usage itself is probably at least approximately interpretable (but I have seen no material named this in Beadle's hand). Subsequent authors simply did not investigate the nomenclatural problem, preferring their own interpretation of Beadle's usage. A practicable solution might appear to be to epitypify *C. glandulosa* Michx. on excellent modern reproductive material that is a presumed best match for Beadle's usage of *C. michauxii*. However, the later applications of this name are too inconsistent or vague to make such an exercise worthwhile. Thus, those authors who include all or most Floridian members of series *Lacrimatae* and *Apricae* under *C. michauxii* ignore the type issue. However, if ser. *Lacrimatae* were to be treated as a single species, the earliest available unquestionably suitable names become *C. alabamensis* Beadle and *C. senta* Beadle, both described in 1900.

This study is based on the examination of well over 1,400 herbarium specimens of ser. *Lacrimatae* including borrowings from 35 herbaria and fairly large collections of duplicates received from R. Lance. It has greatly helped this study to have made my own (JBP) considerable collections of ser. *Lacrimatae*, in many cases with matching fruit and flower specimens. Such fieldwork also enables one to observe habit and color differences that are not evident in herbarium specimens as well as, of course, observing many times more specimens than actually collected. This level of sampling greatly facilitated identifying repeating patterns of variation, sometimes with surprising ease. The repeating patterns are matched against type material, nearly always Beadle's, which is generally of high quality. There were relatively few good quality specimens that are intermediate between accepted taxa. Where "annotations" are referred to under several species discussions this alludes to JBP annotations made prior to final decisions on the correct name and these provisional names were applied because the size and complexity of the project meant that it became inappropriate to retain loans until final decisions could be made.

Some of the characteristics found useful in the taxonomy of ser. *Lacrimatae* include thorn frequency and size, leaf general shape and size, tomentum of pedicel, hypanthium and fruit, flower and fruit size, margination of leaf (manner and extent to which lobed and toothed). A number of species possess long-petiolate leaves that can flutter in the wind or droop (become "floppy") in calm air. These characteristics are so helpful when learning taxa that they are used routinely in our keys and descriptions even though they will not be evident in herbarium specimens. Also, there is some indication that the form of extension shoot leaves in this series, usually passed over in *Crataegus* taxonomy due to its frequently extreme plasticity as well as shortage of identifiable herbarium examples, may prove of taxonomic value when better documented. For example, *C. florens* Beadle and *C. dolosa* Beadle (a form of *C. integra* (Nash) Beadle) apparently consistently possess more or less circular, lobeless extension shoot leaves. As with all modern specialist *Crataegus* taxonomy, short-shoot leaf-shape has been found particularly valuable and we have attempted to articulate this more precisely than Beadle did, both in words and with the numerous line illustrations.

Beadle's keys give somewhat imprecise descriptions of the leaf shapes which are often so diagnostic in *Crataegus*, and this makes positive identification from the keys a challenge, to put it mildly. However, loans of critical types, principally from A, plus easy access to the digitized type collections at US and NY (where the type specimens of many Beadle names are unfortunately attributed to W.W. Eggleston rather than the real collector) greatly helped in making critical determinations. However, names due to Ashe have often presented more or less insuperable typification difficulties of the kind previously discussed in Phipps *et al.* (2006a). Fortunately, it is possible to confidently match all the here-accepted names in *Lacrimatae* against type material without needing to apply any names of Ashe or Murrill.

It became clear early in this study that Beadle was the only previous worker who had made any sense of the great variation in ser. *Lacrimatae*. The 22 species recognized here nevertheless represent a substantial reduction from the 54 species found in Beadle's final account (1903) without being procrustean. As in all the first author's taxonomies that use a similar approach, the complete lack of or at least, low frequency of, intermediates is a critical consideration in coming to decisions on taxon delimitation. The highly dissected variation patterns encountered are thus at pesent most easily treated as rather narrow species some of which may eventually prove to equate to apomictic microspecies, although several other species turn out to be quite variable, e.g., *C. crocea* and *C. condigna*. However, nothing is yet known about the breeding systems or chromosome numbers of ser. *Lacrimatae*, the count for *C. agrestina* Beadle in Talent et al. (2005) actually representing a ser. *Pulcherrimae* individual with correct usage of this name so such valuable interpretive information cannot be used.

Series *Lacrimatae* has a similar geographical range to ser. *Apricae*, but is far more abundant (Fig. 1), with 1458 records in our database compared to 274 for the former series. This far greater abundance of material made most taxonomic decisions easier than for the treatment of ser. *Apricae* (Phipps & Dvorsky 2007), the predecessor to this paper.

This paper provides the first revision of the species included by Beadle (1902, 1903) in his subgroups *Michauxianae*, *Integrae*, *Dentatae*, *Attritae*, *Sentae*, *Anisophyllae*, *Colonicae*, *Recurvae* and *Lepidae* plus elements of *Visendae*. (*Crataegus fruticosa* Sarg. 1902, repeatedly collected around the time of its description and not seen since, is perhaps a hybrid between a member of ser. *Lacrimatae* and ser. *Aestivales* and is excluded.) Most illustrations are firsts and *Crataegus meridiana* is the only widely occurring species not illustrated, both because it is somewhat obscure to characterize and because of lack of really good presumptively typical material. Most maps are also firsts and are presented on a county frequency basis. Most of the illustrations and all the maps are firsts. Complete descriptions are provided for all main species. More obscure forms are treated as subordinate taxa, usually without illustration or map. Often these have abbreviated descriptions. All taxa and synonyms used are typified. Synonymy, however, is somewhat incomplete (as it is for most North American series), here largely due to problems with Ashe names. As in other recent publications in this series, Ken Dvorsky is responsible for creating the maps. An appendix of cited specimens is provided.

TAXONOMIC PART

Series **Lacrimatae** J.B. Phipps, Taxon 37:113. 1988. Type species: *Crataegus lacrimata* Small, Torreya 1:97. 1901.

Shrubs, sometimes very small, or small trees; bark on trunks black or dark gray and highly corrugated (presumably fire-resistant), unlike that of most other *Crataegus* series; ultimate branches pendulous, particularly in the very slender-twigged species, also zigzag at the nodes, often purple-brown at 1 year; thorns mostly 1–5 cm long, none to numerous, ± straight, usually slender, very dark at 1 year. Leaves deciduous, petioles very short to long (10–40% length blade); blades small (1–4 cm long), ovate to oblong in general shape, usually shallowly lobed; margins entire to toothed, very glandular; lateral veins 1–5/side, exiting mainly or wholly in the apical part of the blade; tomentose, at least when young in most species. Inflorescences 1–4(–7)-flowered; the branches in many species densely appressed white-pubescent, bearing small, deciduous, linear, membranous, gland-margined bracteoles with generally high persistence through anthesis. Flowers 10–20 mm diam.; hypanthium often tomentose; calyx-lobes ± narrow-triangular, entire to glandular-dentate; petals ± circular or rarely elliptic, white; stamens 20, anthers usually white to cream; styles 3–5. Fruit 6–12 mm diam., pyriform to orbicular, yellow through orange and copper to red, one face often colored most brightly, smooth or with scattered hairs; calyx-lobes usually reflexed; nutlets 3–5, dorsally grooved, sides plane. Most species ripen their fruit in August, before sympatric hawthorns.

Series *Lacrimatae* constitutes a characteristic and frequently abundant element of the sand plains, scrubby areas and pinelands of the southeastern United States coastal plain and piedmont from Louisiana east of the Mississippi, south to central Florida thence north on both sides of the Appalachians and extreme southeastern Virginia. Treated here are 22 usually fairly narrowly defined species and six more obscure

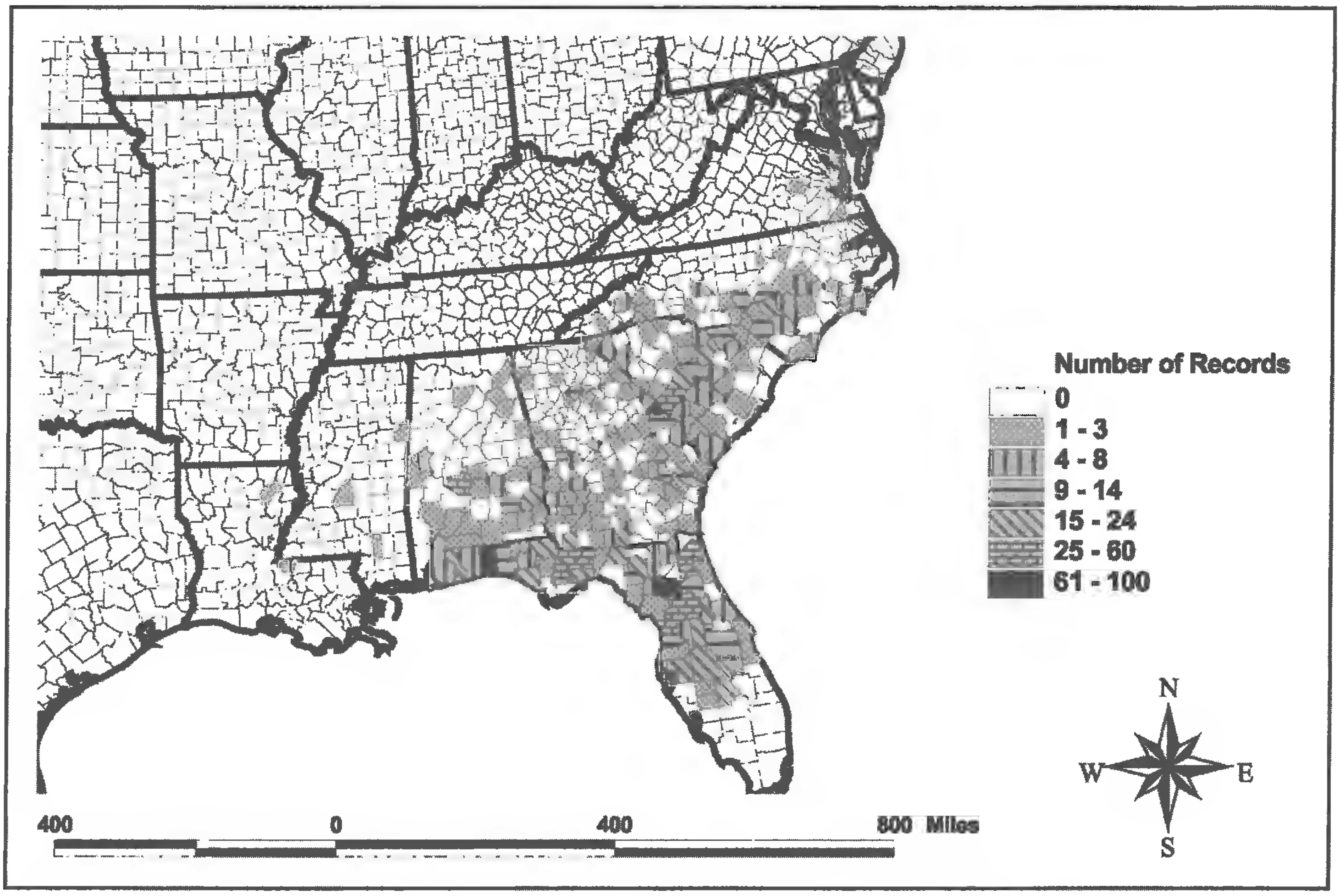

FIG. 1. County level distribution map of collated species.

entities indicated by adding a subscript to the number of a similar species. This compares to the 54 species recognized by Beadle (1902, 1903).

LII (leaf incision index or IFI in Latin) refers to the degree to which lobed leaves are dissected and ranges from 0% (without lobes) to 100% (cut to the midvein). Different sinuses may vary in LII and the value given refers to a typical value for the deepest sinus.

KEY TO SERIES LACRIMATAE

1. Habit often rather slender with ultimate branches particularly fine and pendulous and capable of movement in slight wind, else dwarf shrubs 0.5–1 m tall at maturity; twigs slender, often only 1.5 mm thick at about 5 cm from the tip; thorns fine, usually 1–4 cm long; blades usually 1–4 cm long, rather thin, drooping or fluttering in many species; fruit usually small, 6–8 mm diam., often yellow with a crimson cheek (subser. ***Tenues***).
    2. Leaf-blades 1–2(–3) cm long, as broad as long to slightly longer than broad (1–1.4:1).
        3. Dense twiggy shrubs seldom reaching 2 m tall, not notably lacrimate except sometimes in larger specimens; often flowering at 0.3 m tall; leaves glossy, semi-evergreen; blades < 2 cm long, ± isodiametric to broad obovate-truncate, not lobed to obscurely lobed across the terminal end, their margins ± entire to with conspicuous distal glandular-scalloped leaf-marginal teeth; extension shoot leaves very much like short-shoot leaves but larger and shallowly lobed ________ **1. C. lepida**
        3. Larger shrubs or small trees 2–7 m tall at maturity, nearly always ± evidently lacrimate; seldom flowering at less than 1 m tall; leaves not glossy, deciduous in fall; blades1–2(–3) cm long, nearly always broadest in apical half, broad obovate to obtrullate in general shape, usually with 1–2 rather short blunt to ± acute lobes distally per side; margins obscurely crenate to evidently crenatoserrate distally; extension shoot leaves frequently flaring outwards towards the tip, their large obtuse distal end being quite deeply and somewhat irregularly lobed ________ **2. C. egens**
    2. Leaf-blades 2–5 cm long, significantly longer than broad (1.4–2:1).
        4. Inflorescence branches and hypanthium ± glabrous.

5. Leaf-blades 1–1.75 cm long, teeth ± regular; petals 5–7 mm long; ripe fruit yellow with a red cheek **3. C. lacrimata**

5. Leaf-blades 2.25–4.00 cm long: teeth larger and more irregular; petals 7–9 mm long; ripe fruit deep or dull orange-copper **3a. C.** sp. cf. **C. lacrimata**

4. Inflorescence branches and hypanthium pubescent to tomentose.

6. Leaf margins entire to subentire, or, if toothed, teeth very fine and entirely restricted to terminal part of leaf.

7. Leaf-blades oblong-obovate to very narrowly elliptic in general shape, margins entire to finely serrato-crenulate across the tips, sometimes with occasional small sharp teeth on the sides.

8. Leaf-blades narrow elliptic to narrow oblanceolate, 1.8–3:1; tips acute **5. C. crocea** (typical form)

8. Leaf-blades proportionately broader, ± broad elliptic to broad rhombobovate to ± cuneate-spathulate, 1.5–2.0:1; tips rounded to flattish, at most the end very flat triangular or weakly mucronate.

9. Leaves proportionately longer, ± cuneate-spathulate **5. C. crocea** (villaris form)

9. Leaves proportionately shorter, broad rhombobovate to ± broad elliptic 5. **C. crocea** (incana form)

7. Leaf-blades narrowly rhombic in general shape, margins nearly entire **8a. C.** sp.

6. Leaf margins distinctly, though often shortly, lobed and/or toothed.

10. Dense twiggy shrubs seldom reaching 2 m tall, not notably lacrimate except sometimes in larger specimens; often flowering at 0.3 m tall; leaf-blades cuneate to narrow elliptic, often almost parallel-sided, margins sharply toothed but not lobed, < 2 cm long **4. C. munda**

10. Larger shrubs or small trees 2–7 m tall at maturity, nearly always ± evidently lacrimate; seldom flowering at less than 1 m tall; leaf blades 1.5–4 cm long, more obtrullate in general shape, ± lobed apically, margins sometimes crenate or crenato-serrate.

11. Leaf apex flattish to rounded or ± triangular; lobes subterminal, well-defined or sometimes obscure or obtuse; petioles fairly long (25–50% length of blade); blades thin, capable of fluttering in wind; thorns few or none, ± slender, ca. 2 cm long.

12. Leaf apices obtuse to flattish in general shape; lobes obscure or lacking young or more noticeable at maturity when small, subacute, margins evenly crenate-dentate **5a. C. vicana**

12. Leaf apex rounded to triangular in general shape, with well-defined subterminal +/- acute lobes.

13. Blades usually 1–3 cm long, +/- stiff to fluttering in wind; petioles 5–10 mm long.

14. LII on broader leaves < 20%; leaves at anthesis larger than flowers; extension-shoot leaves unlobed or lobed much less than LII 80% **6. C. quaesita**

14. LII on broader short-shoot leaves ca. 20%; leaves at anthesis about size of flowers; larger extension-shoot leaves deeply lobed (LII to 80%) **6a. C.** sp. aff. **resima**

13. Blades often reaching 3–4 cm, though normally some shorter, larger able to flutter in the wind; petioles 10–20 mm long **7. C. floridana**

11. Leaf apex rounded to ± triangular with obscure or obtuse lateral lobes; petioles fairly short (< 25% length of blade); blades stiff and non-fluttering in wind; very thorny, thorns ± stout, 3–5 cm long **8. C. invicta**

1. Habit more robust and stocky though ultimate twigs usually ± pendulous in mature specimens; twigs thicker, at least 1.5 mm and often 2–3 mm wide at about 5 cm from the tip; thorns, if present, normally relatively stout, 2–5 cm long; blades often rather thick and stiff, commonly 2.5–4.0 cm long; fruit usually larger, 8–12 mm diam., often copper-colored at maturity (subser. ***Robustae***).

15. Leaves in most specimens without lobes, but when present, these subterminal, few and obscure and very short-triangular or merely undulate, margins toothed or not.

16. Leaf marginal teeth, if any, merely denticulate.

17. Thorns generally absent; most leaf-blades 2.5–4 cm long; flowers 15–20 mm diam.; fruit 10–12 mm diam.

18. Leaf-blades 2–4 cm long, many at least twice as long as broad, ± cuneate in general shape; tip obtuse to cuspidate, sides evenly tapered from just below broadest point to junction with petiole; petiole 10–15 mm long; leaves 'floppy' in nature. **16. C. lassa**

18. Leaf-blades often 2.0–3.5 cm long, 1.2–1.8 x as long as broad, usually proportionately broader than above (but occasionally proportionately narrower), general shape somewhat variable, ± obovate, broad rhombobovate to ± broad elliptic, or even suborbiculate; tip varied in form, acute to subcuspidate, alternatively truncate-obtuse; and sometimes obscurely undulately lobed around broadest point; petiole 3–8 mm long, leaves stiff______**11. C. integra**

17. Thorns long, numerous; leaf-blades 2–2.5 cm long; flowers 12–15 mm diam.; fruit 6–9 mm diam ______**12. C. colonica**

16. Margins with well-defined teeth.
  19. Hypanthium and pedicels tomentose.
    20. Margins with fine regular teeth; leaves lacking lobes.
      21. Leaf-blades broad-elliptic to narrow obovate or obovate in general outline, obtuse to somewhat cuspidate across the tip; inflorescences 2–7-flowered; flowers 14–25 mm diam.; thorns absent or scarce, if present, 20–30 mm long.
        22. Leaf-blades narrow obovate to broad elliptic in general shape; apex rounded to broadly acute; flowers 13–20 mm diam ______**9. C. condigna**
        22. Leaf-blades broad-oblong to cuneate, ± flattened at apex or slightly cuspidate; flowers 22–25 mm diam. ______ **10. C. alabamensis**
      21. Leaf-blades obovate to obovate-rhombic in general outline, generally subacute to obtuse the tip; inflorescences 1–3-flowered; flowers ca. 12 mm diam; thorns abundant, 35–50 mm long ______**13. C. pexa**
    20. Margins with coarse, irregular teeth, some leaves with one shallow lobe per side ______ **15b. C. pulla**
  19. Hypanthium and pedicels glabrous to thin-pubescent.
    23. Leaf marginal teeth finely dentate; leaves with 2–4 pairs of lateral veins; twigs barely flexuous; inflorescence branches subglabrous; styles and nutlets 2–3______**14. C. teres**
    23. Leaf marginal teeth coarse and/or sharp, dentate; leaves with 1–4 pairs of lateral veins; many twigs evidently zigzag; inflorescence branches pilose-pubescent or subglabrous; styles and nutlets 3–5.
      24. Leaf-blades quite large, 2.0–4.5 cm long; pairs of lateral veins 2 –4; inflorescence branches thinly to moderately pilose-pubescent______ **15. C. florens**
      24. Leaf-blades smaller, 1.5–3.5 cm long; pairs of lateral veins 1–2; inflorescence branches subglabrous ______**15a. C. attrita**

15. At least 40% of leaf-blades distinctly lobed, but sometimes very shallowly; margins often also toothed.
  25. Blades 2–5 cm long at maturity; most leaves ± narrow in general shape, many >1.75:1, elliptic to narrow-obovate or narrow-obtrullate.
    26. Mature leaf-blades 30–50 mm long, floppy; 1–2 small subterminal lobes per side; flowers 17–20 mm wide ______ **17. C. lanata**
    26. Mature leaf-blades 15–30 mm long, stiff; lobes well-defined and ± sharp (except sometimes in *C. lancei* where many sometimes lobeless); flowers 14–16 mm wide.
      27. Lobes (frequently absent) 0–1 per side, small, subacute; teeth crenate to crenate-serrate; lateral veins 1–3 per side; inflorescences 3–7-flowered______**20. C. lancei**
      27. Lobes (present on all leaves) 1–2 per side, and teeth well-defined, sharp; lateral veins 3–5 per side; inflorescences 2–4-flowered ______ **21. C. senta**
  25. Blades 1.5–4 cm long at maturity; two-thirds or more leaves broader in general shape, mainly ca. 1.4–1.6:1.
    28. Blades usually broadest towards the tip, ± broad-obtrullate to obtrullate-rhombic or obovate in general shape, rather longer than wide, lobes (0–)1–3 per side subterminal, distinct; anthers cream.
      29. Leaf-blades stiff, often persistently lanate; lobes 1–2 per side, subterminal to lateral, generally rather obscure ______ **18. C. furtiva**
      29. Leaf-blades stiff or floppy, persistently lanate or not; at least one prominent subterminal lobe per side.
        30. Inflorescences 2–4-flowered; leaves lanate initially, remaining pubescent, lobes 1–2 per side, sharp at least when young; teeth sharp or not.
          31. Leaf-blades obovate-obtrullate in general shape; lobes 1–2 per side; marginal teeth small, crenate-serrate______ **19. C. meridiana**
          31. Leaf-blades obovate to broad-obovate in general shape; lobes, usually 2 per side; marginal teeth very sharp ______ **22. C. dispar**
        30. Inflorescences 3–7-flowered; leaves glabrescent; lobes usually1(–0) per side, broad but acute; marginal teeth very small, sharp______**23. C. exilis**

28. Blades broadest in the middle, rhombic in general shape, a little longer than wide, with one distinct ± acute lobe per side; anthers pink to purple ______________________ [**C. egregia** (ser. **Apricae**)]

Subseries **Tenues** J.B. Phipps, subser. nov. (spp. 1–8). TYPE SPECIES: *C. recurva* Beadle.

Habitus vulgo aliquantum tenuis cum ramulis ultimis praecipue gracilibus pendulisque et capacibus motus in vento exiguo, duobus speciebus fruticosis nanis 0.5–2.0 m altis in maturitate exceptis; ramuli graciles, saepe solum 1.5 mm crassi ca. 5 cm ab apice; spinae graciles, vulgo 1–4 cm longae; laminae vulgo 1–4 cm longae, aliquantum tenues, demissae vel tremaefactae in vento levissimo in multibus speciebus; fructus vulgo parvi 6–8 mm diametro, pyriformes vel late-ellipsoidei vel interdum suglobosi, saepe flavi cum carmesinis genis.

Habit usually rather slender with ultimate branches particularly fine and pendulous and capable of movement in slight wind except in two dwarf shrubby species 0.5–2.0 m tall at maturity; twigs slender, often only 1.5 mm thick at about 5 cm from the tip; thorns fine, usually 1–4 cm long; blades usually 1–4 cm long, rather thin, drooping or fluttering in many species; fruit usually small, 6–8 mm diam., pyriform to broad ellipsoid, occasionally subglobose, often yellow with a crimson cheek.

1. Crataegus lepida Beadle, Biltmore Bot. Stud. 1:36. 1901. **(Fig. 2)**. TYPE: U.S.A. GEORGIA. Ware Co.: Waycross, 24 Aug 1901, *C.D. Beadle 3041* (LECTOTYPE, selected here, US).

Shrubs, often less than 1 m tall but sometimes reaching 2 m, dense and twiggy, not notably lacrimate except sometimes in larger specimens, capable of flowering at 0.3 m tall; bark of trunk scaly, dark grey; young twigs appressed-pubescent, 1-year old twigs brown, zig-zag at nodes; thorns 0.6–2 cm long, fine, straight. Leaves late deciduous to wintergreen; petioles 25–40% length of leaves, pubescent, glandular; blades 0.6–1.5 cm long, broadly obovate to± isodiametric in general shape; tip very obtuse or with a slight apiculus, base abruptly contracted into the winged upper portion of the petiole; sometimes with extremely shallow lobes across apical third; margins minutely glandular-crenate to sometimes with conspicuous distal glandular-scalloped teeth distally; venation craspedodromous, 1–2 main lateral veins per side; surfaces very slightly appressed-pilose above when young, more particularly so on the veins, ± pubescent below, especially on the veins; coriaceous and often somewhat glossy; stipules herbaceous, falcate, gland-margined. Inflorescences 1–3-flowered; branches appressed-pubescent, bearing deciduous, linear, membranous, gland-margined bracteoles. Flowers ca. 12 mm diam.; hypanthium externally pubescent; calyx-lobes abaxially pubescent, triangular, margins ± entire; petals ± circular, white; stamens 20, anthers ivory; styles 3–4. Fruit 8–13 mm diam., slightly longer than broad, ± pubescent, yellow-green to yellow or orange when ripe, black gland-dotted; calyx-lobes recurved or broken off; nutlets ca. 3, dorsally grooved, sides plane.

Common name.—Dwarf Hawthorn.

Distribution (Fig. 3).—This is a scarce species occurring in the southeastern United States in scattered localities from central Florida to Georgia and South Carolina where it is found in dwarf scrub. Remarkably, a sterile specimen, *Thomas 57507*, from Louisiana, appears to be this species.

In central Florida plants flower and begin their extension growth very late, in May, long after growth of other nearby plants has started, however, further north, anthesis about the second week of April seems more normal for this species. The former are the most wintergreen populations. Particularly small-leaved specimens with numerous, small, sharp marginal teeth may represent *C. garrettii* of Murrill.

This is a dwarf semi-evergreen shrub, very attractive, with dark, glossy, often suborbiculate leaves that are very striking in the field. Larger specimens might be confused with *C. egens*.

2. Crataegus egens Beadle, Biltmore Bot. Stud. 1:85. 1902. **(Fig. 4)**. TYPE: U.S.A. FLORIDA. Liberty Co.: Bristol, 1 Apr 1901, *T.G. Harbison 4037* (LECTOTYPE, selected here: GH; ISOTYPES: A, US).

? = *Crataegus cirrata* Beadle, Biltmore Bot. Stud. 1:101. 1902. TYPE: U.S.A. ALABAMA. Russell Co.: Girard, no date, *C.D. Beadle 4122* (LECTOTYPE, selected here: US):

Comment.—Beadle 4123, also from Girard, was collected 9 Apr 1910.

Shrubs or small trees to 5 m tall, slender, with pendulous branches, seldom flowering at less than 1 m tall; extending shoots white-canescent; 1-year old purple-brown, older darker or grayer; unarmed or with

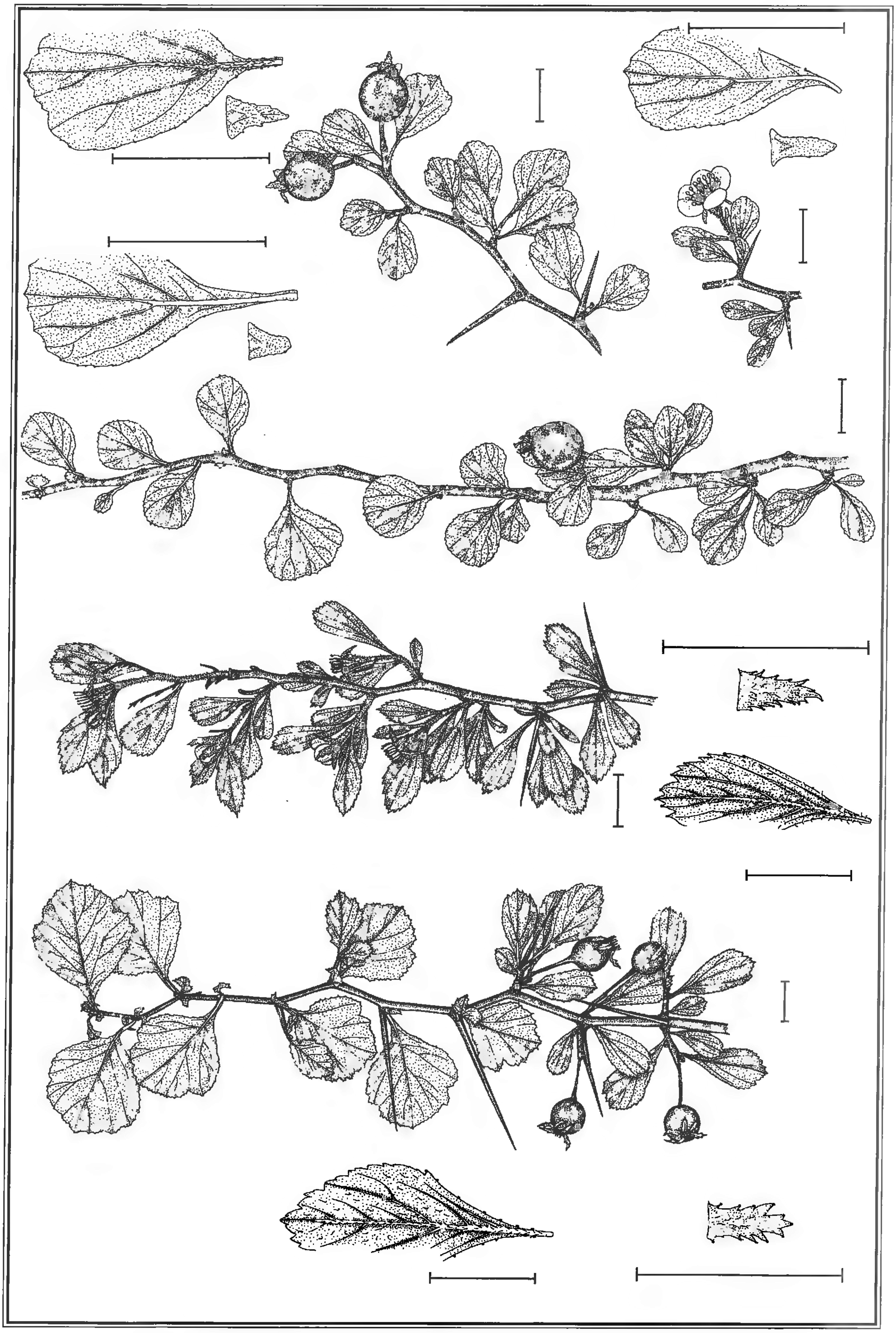

Fig. 2. Line drawings of: *Crataegus lepida* (right) from *S. Riefler s.n.* (UWO), flowering and *J.B. Phipps 6992* and *J.B. Phipps 6749* (both UWO), fruiting; and *C. munda* (left) from *R. Kral 1969* (TENN), flowering and *K.E. Rogers 1404A* (GH) and *W. Faircloth 3579* (GA), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

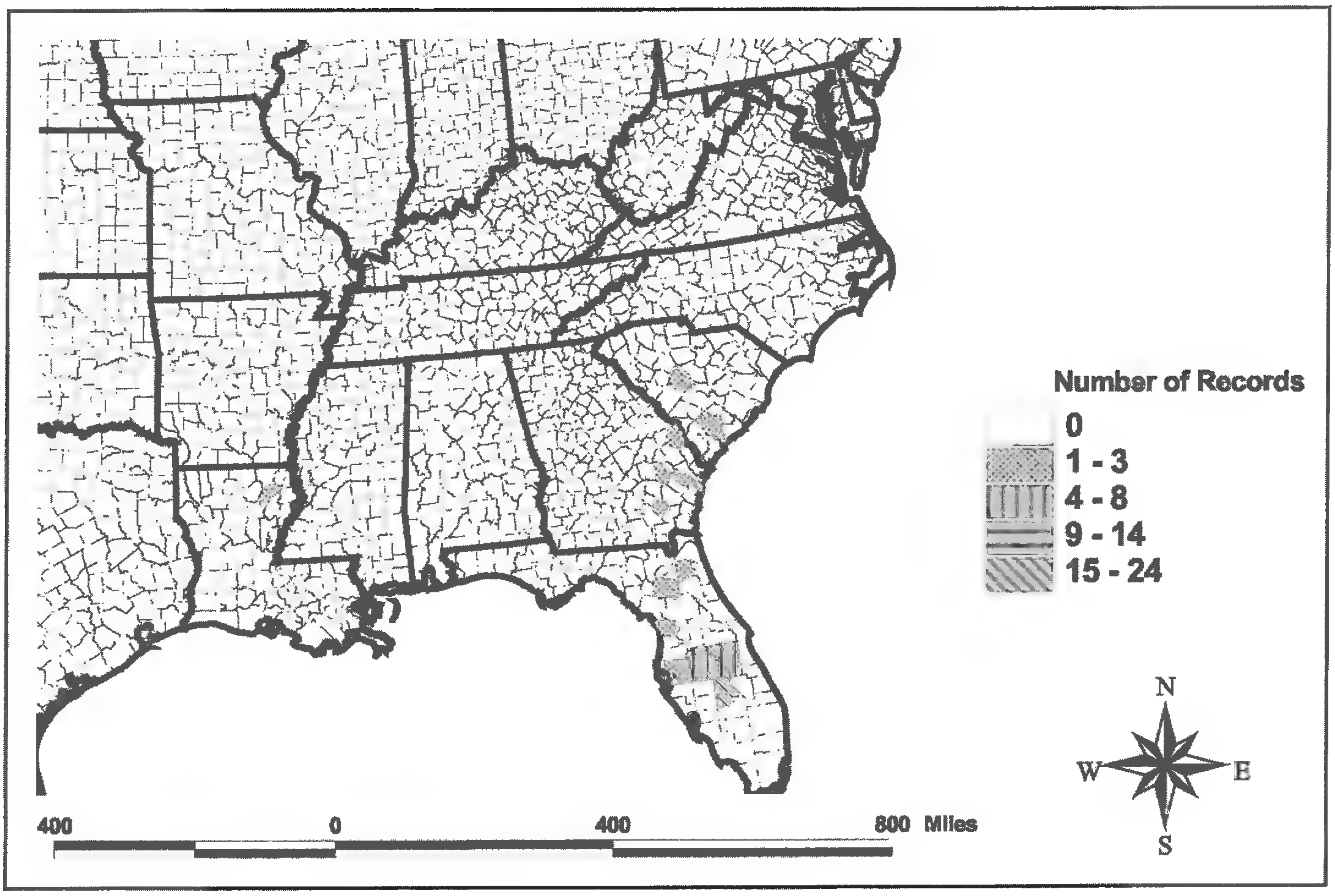

Fig. 3. County level distribution map of *Crataegus lepida* (range recently extended to Cook Co., Georgia).

thorns 1–2 cm long, fine, straight or slightly recurved, blackish to deep gray. Leaves deciduous; petioles 6–18 mm long, very slender below the wing margin, pubescent, gland-margined; blades 1–2(–3) cm long, short-obtrullate to broadly obovate in general shape, broadest in the apical half, cuneate to slightly rounded at the base and tapering into winged petioles, subacute at the apex, usually with 1–2 short, generally subacute lobes per side across the apical end; margins obscurely crenate to evidently crenotoserrate in distal half, glandular; venation craspedodromous, main veins 1–2 per side, exiting at or beyond at the widest part; when young thinly hairy, soon glabrate except on the veins below. Inflorescences 1–2-flowered; branches densely appressed white-pubescent, bearing a few deciduous, linear, membranous, gland-margined bracteoles. Flowers 12–16 mm diam.; hypanthium white-tomentose; calyx-lobes 2–3 mm long, pubescent externally, gland-margined; petals ± circular, white; stamens 20, anthers ivory; styles usually 3. Fruit 8–10 mm diam., subglobose, ± glabrous, deep dull yellow or same with red cheek; calyx-lobes appressed, sometimes late circumscissile; nutlets ca. 3, dorsally sulcate, sides smooth.

Distribution (Fig. 5).—This species is found in the southeastern United States where it is locally common in Georgia and north central Florida, outliers occurring in Clark and Henry Cos., Alabama and Jasper Co., South Carolina. There used to be a fine specimen, fully 6 m tall, on the University of Florida campus at Gainesville in the 1980s.

The drooping, long-petiolate leaves are very small and short-obtrullate to broadly obovate in shape. In general the proportions are broader than 1.4:1. There is some variation in leaf lobing from quite sharp to rather blunt and even obscure. An additional characteristic of this species is the way in which extension shoot leaves may flare outwards towards the tip, their obtuse and large terminal end being quite deeply and somewhat irregularly lobed. Specimens of *C. egens* of lower stature (1–2 m tall) may be distinguished from *C. lepida* by that species' nearly or completely unlobed, coriaceous and shiny leaves. Specimens with

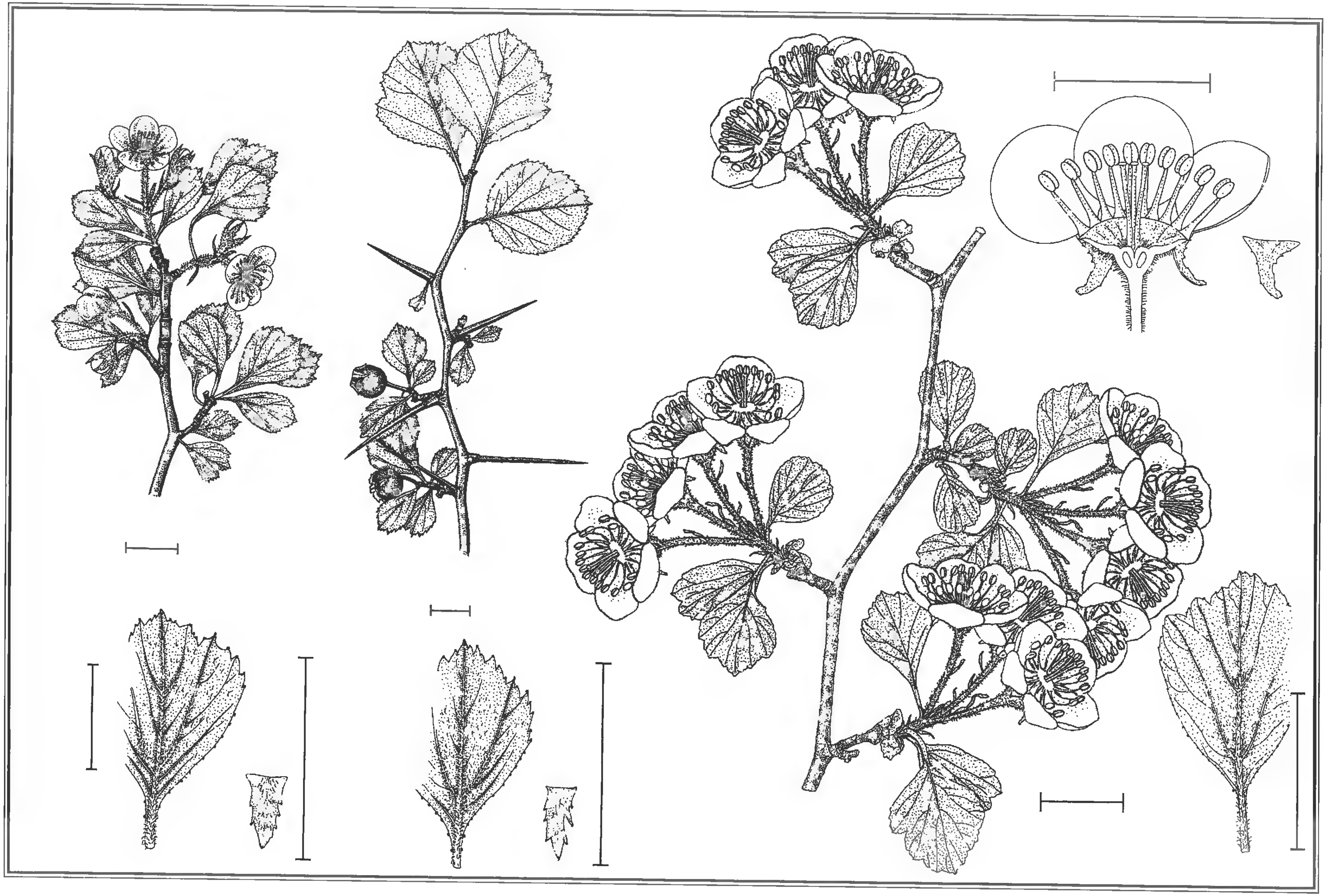

Fig. 4. Line drawing of *Crataegus egens* from *T.G. Harbison 6023* (NCU) and *J.B. Phipps 6652* (UWO), left and right flowering respectively and *M.L. Fernald & B. Long 6604* (US), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

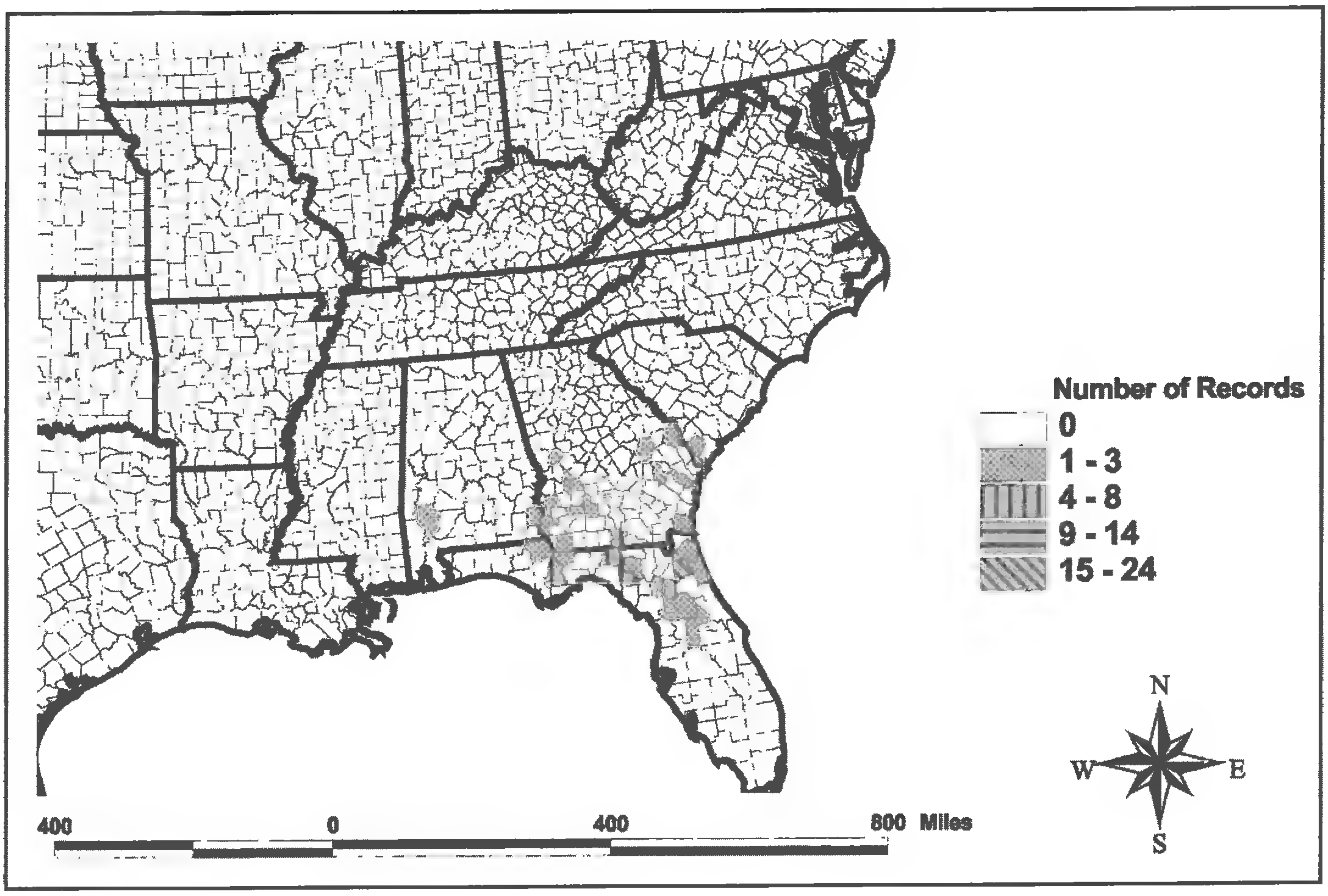

Fig. 5. County level distribution map of *Crataegus egens.*

leaves of the above general shape but more elongated may be referred to *C. cirrata* and are thus somewhat intermediate with *C. floridana*.

3. Crataegus lacrimata Small, Torreya 1:97. 1901. (**Fig. 6**). See also Pl. 27 in Phipps et al. (2003). Type: U.S.A. Florida. Okaloosa Co.: Crestview, 8 Apr 1899, *C.D. Beadle 17* (lectotype, selected here: US).

Shrubs to 5(–8) m tall; twigs zig-zag at the nodes; growing shoots pubescent, 1 to 2-year old shoots gray or purple-gray; thorns 1.5–3.0 cm long, straight, purple-gray. Leaves deciduous; petioles 2–6 mm long, slender, pubescent; blades 1–2 cm long, oblong, ± narrowly obtrullate or occasionally elliptic, the tip truncate to obtuse to occasionally cuspidately subacute, subentire to toothed in distal half or very occasionally very slightly lobed; veins 1–2 per side, exiting in the distal half of the leaf; surfaces glabrous. Inflorescences 1–3-flowered; pedicels glabrous, bearing ± caducous, linear, membranous, eglandular to more usually few-gland-margined bracteoles; flowering 8 April '91 in the Florida panhandle. Flowers ca. 15 mm wide; hypanthium externally glabrous; calyx-lobes 2–3 mm long, triangular, abaxially glabrous, margins ± entire; petals ± circular, white; stamens 20, anthers cream; styles 3–4. Fruit ca. 8 mm wide, ± orbicular, glabrous, yellow, yellow blushed red, or red; calyx remnants patent-reflexed; nutlets dorsally grooved, sides plane.

Common name.—Weeping Hawthorn.

Distribution (Fig. 7).—This species is found over the Florida panhandle and adjacent Alabama and extends through Georgia into South Carolina. It is extremely abundant between Pensacola and Panama City, and locally common elsewhere in pinewoods and open scrub.

Crataegus lacrimata occurs as an attractive, ± upright, usually single-stemmed shrub with slender ± weeping branches and small, narrow, glabrous, bright green leaves and is easily recognized among ser. *Lacrimatae* from all except the species 3a. This and the next are the only members of ser. *Lacrimatae* to commonly possess eglandular bracteoles.

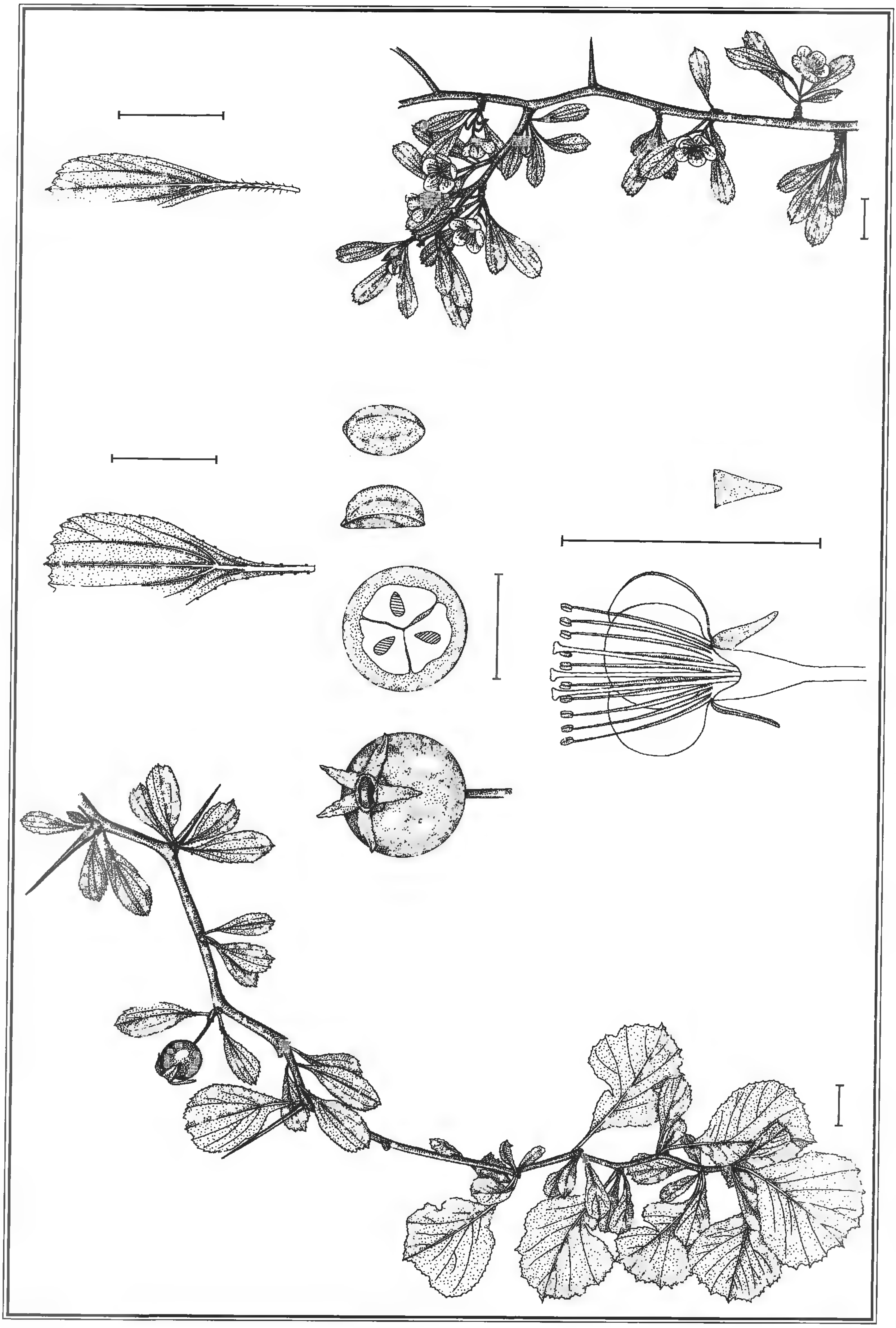

Fig. 6. Line drawing of *Crataegus lacrimata* from *R. Kral 26149* (TENN), flowering and *R.K. Godfrey 54630* (FSU) and *R. Kral 31806* (TENN), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

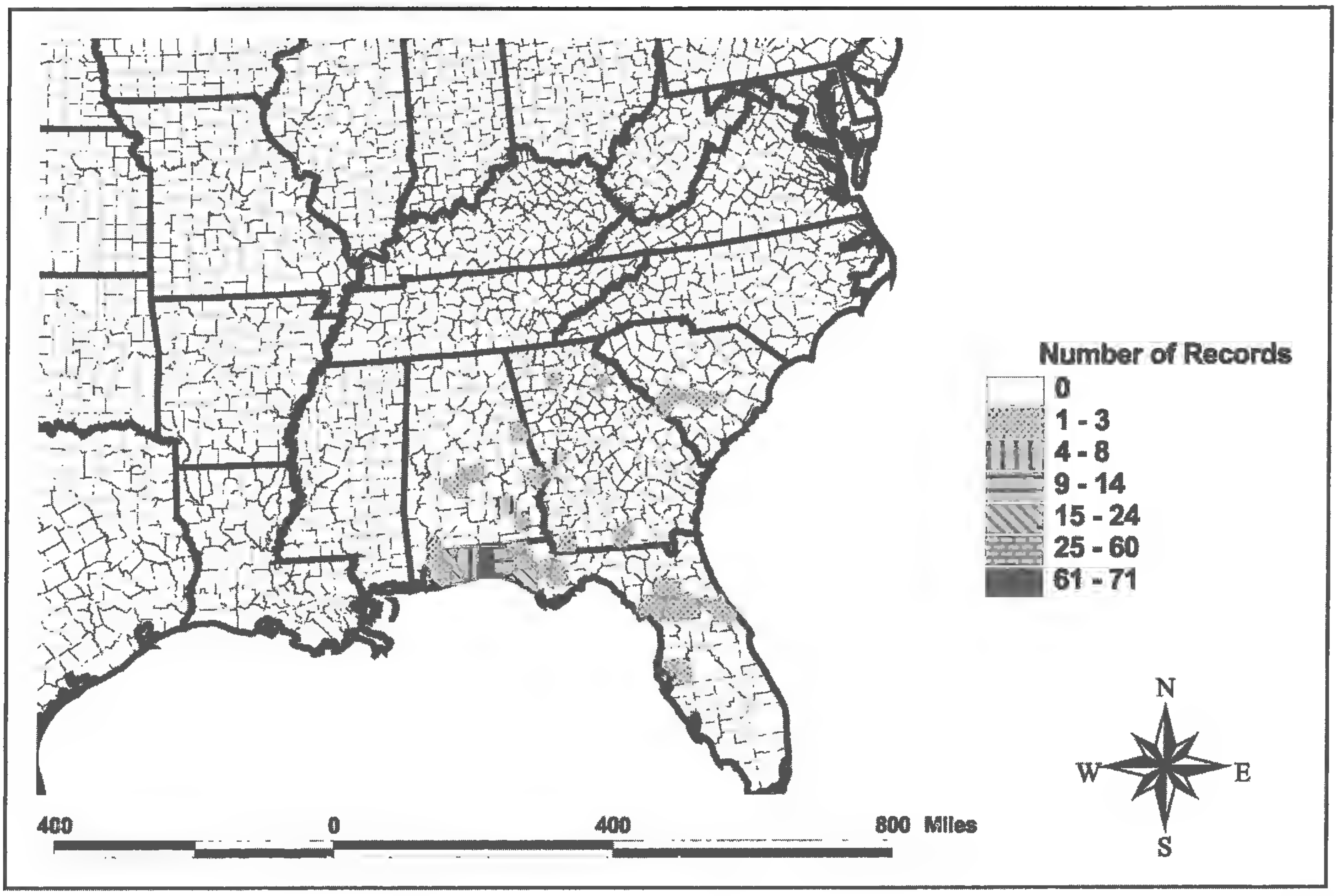

Fig. 7. County level distribution map of *Crataegus lacrimata*.

3a. Crataegus sp. cf. **lacrimata** Small, Torreya 1:97. 1901.

Shrubs 2–4 m tall; twigs of the current year glabrous, twigs zig-zag at nodes; 1-year old twigs deep dull purple; thorns mostly 1–4 cm long, few to numerous, straight. Leaves deciduous; petioles 2–6 mm long, pubescent, glandular; blades 2–4 cm long, narrowly oblong to narrowly oblanceolate, unlobed; distal third markedly toothed with gland-dotted teeth; base narrowly cuneate; venation craspedodromous with about 2 veins per side diverging at a narrow angle from the midrib and exiting in the distal quarter or third; mostly glabrous except for tufts of hairs in the axils of the veins below. Inflorescences 1–3(–4)-flowered; branches glabrous, bearing a few deciduous, linear, membranous, ± eglandular, bracteoles. Flowers ca. 18 mm diam.; hypanthium externally glabrous; calyx-lobes narrow-triangular, glabrous, margins gland-toothed; petals ± circular, white; stamens 20, anther cream; styles 3. Fruit 7–15 mm diam., ± orbicular, glabrous, usually deep or dull orange-copper when ripe; calyx remnants variably present; nutlets ca. 3, dorsally grooved, laterally smooth.

Distribution.—This entity occurs in the southeastern USA from the Florida panhandle to Georgia and South Carolina. It is found in open scrubland, principally on sand or sand-plains where it is locally common.

It is very similar to *C. lacrimata* but differs in its conspicuously larger leaves, flowers and fruit.

4. Crataegus munda Beadle, Biltmore Bot. Stud. 1:38. 1901. (**Fig. 2**). Type: U.S.A. South Carolina. Lexington Co.: Batesburg, 31 Jul 1900, *C.D. Beadle 2821* (lectotype, selected here: US).

? = *Crataegus geniculata* Ashe J. Elisha Mitchell Sci. Soc. 17:16. 1900. *Comment*.—no authentic material of this taxon can be located but the protologue suggests something very like *C. munda* in whose main range it lies.

Stiff, compact thorny shrubs 0.5–2 m tall, or occasionally (? misidentified) much taller; twigs zig-zag, those of the season densely appressed-pubescent, green, 1-year old twigs purple brown-gray; thorns 1–3 cm

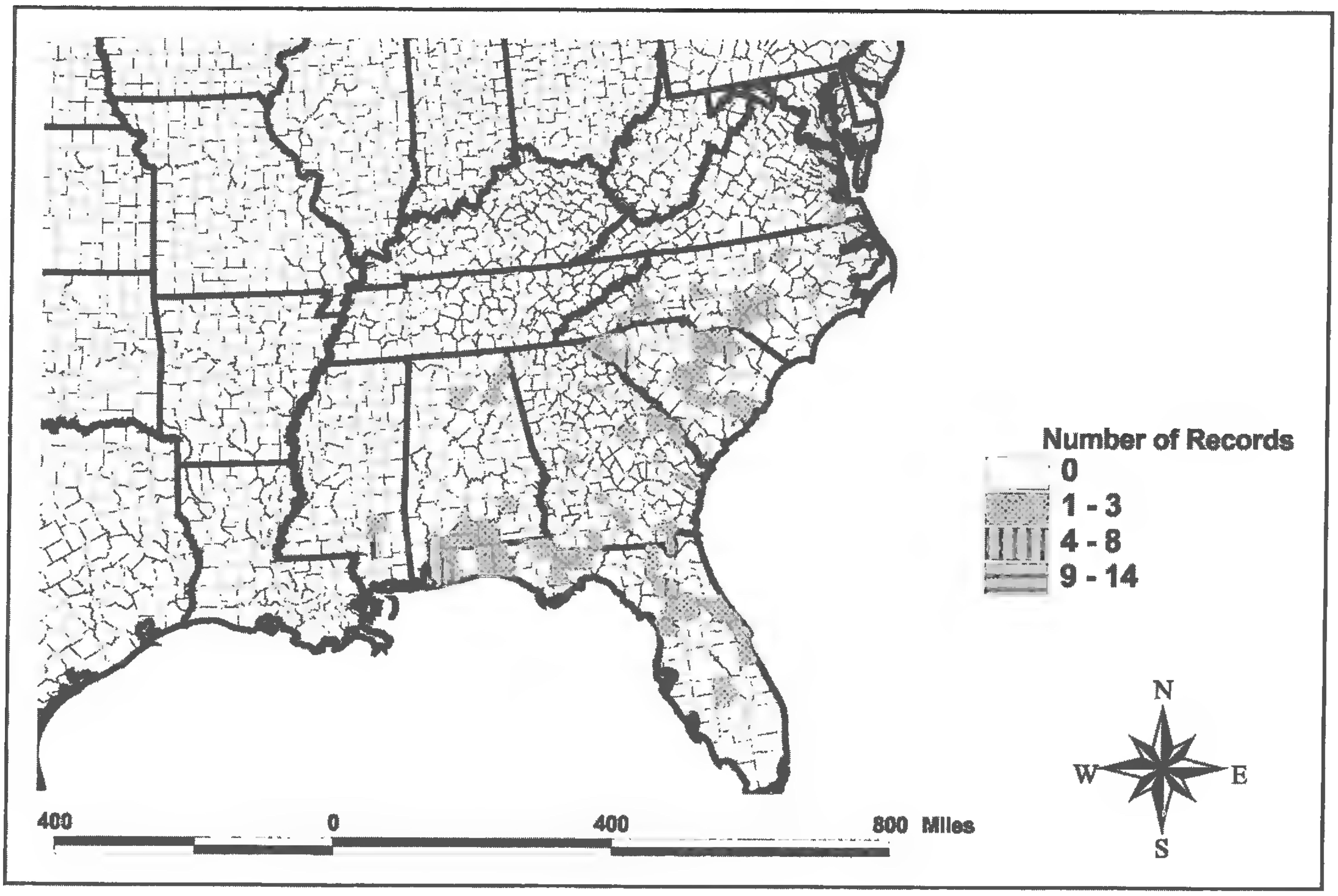

Fig. 8. County level distribution map of *Crataegus munda*.

long, slender, ± straight, purple-brown at 2 years. Leaves deciduous; petioles 0–5 mm long, winged above, pubescent only when young, glandular; blades 8–18 mm long, narrowly obovate to cuneate to oblanceolate, with ± straight sides, tapered to the base; tip typically blunt, and sometimes obscurely 3–lobed, more rarely acute; margins finely serrate-crenate in distal half, the teeth glandular; venation craspedodromous with 1–2 pairs of lateral veins, these exiting above the broadest part of the leaf; thinly pubescent above and below even at maturity, ± densely pubescent below near the vein axils; dark green when young, generally shiny and thin-chartaceous at maturity; stipules thin, approximately obtriangular. Inflorescences 1–2(–3)-flowered; branches ± thinly appressed-pubescent, bearing deciduous, linear, membranous, gland-bordered bracteoles. Flowers ca. 12–15 mm diam.; hypanthium externally pubescent below; calyx-lobes triangular, gland-toothed, abaxially pubescent mainly; petals ± circular, white; stamens 20, anthers ivory or rarely light purple (*C. visendiformis*); styles 3–5. Fruits ca. 7–8 mm diam., subglobose, subglabrous, red; calyx remnants appressed; nutlets 3–5, dorsally sulcate, laterally smooth.

Distribution (Fig. 8).—This is one of the most widespread species in the series. It occurs from North Carolina to central Florida, southeastern Alabama and South Carolina with scarce outliers occurring in Mississippi (Jones, Forest Cos.) and Virginia (Nansemand Co.). It is found mainly on sandy soils, in open brushy places or among pine.

Crataegus munda has a stiff compact habit, like *C. lepida*, that generally lacks the pendulous twigs so generally typical of the series. Herbarium specimens of *C. munda* somewhat resemble *C. lacrimata*, but, instead, have pubescent pedicels and shorter petioles, are more likely to have pointed leaves and have more pronounced marginal teeth. Similarities may also exist to narrower forms of *C. recurva*, which, however, has more generally pendant, ± entire leaves, usually much longer petioles and more nearly tomentose inflorescences and hypanthia. *Crataegus munda* is one of the few species that regularly flowers at under 1 m tall and resembles *C. lepida* in this respect. It has been recorded with attractive pink flowers east of Geneva, Georgia.

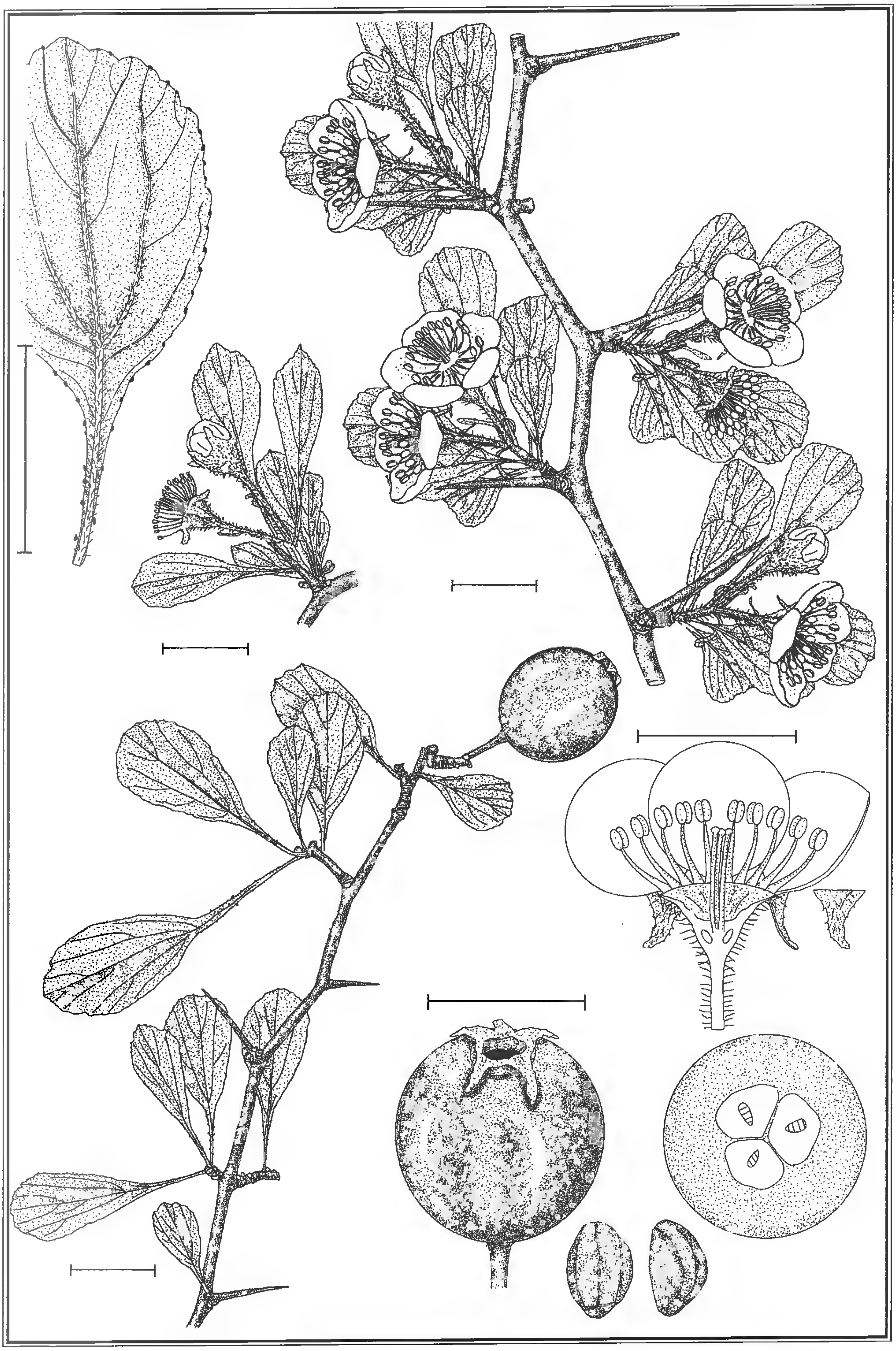

Fig. 9. Line drawing of *Crataegus crocea* from *J.B. Phipps 5132* (UWO) and *R.K. Godfrey 79497* (FSU), flowering and *J.B. Phipps 6762* (UWO), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

A similar form perhaps keying out to *C. geniculata* Ashe, with generally larger, more sharply toothed leaves, 3–4 veins per side, larger flowers with less hairy pedicels and subpyriform fruit has been found by R. Lance in northeastern Georgia.

5. Crataegus crocea Beadle, Biltmore Bot. Stud. 1:113. 1902. (**Fig. 9**). Type: U.S.A. Florida. Marion Co.: Citra, 21 Aug 1901, *C.D. Beadle 4445*^{2} (lectotype, selected here: US).

Crataegus curva Beadle, Biltmore Bot. Stud. 1:109. 1902. Type: U.S.A. Florida. Duval Co.: Jacksonville, 15 Aug 1901, *C.D. Beadle 4082*^{2} (lectotype, selected here: US). U.S.A. Florida. Duval Co.: Jacksonville, 30 Mar 1901, *C.D. Beadle 4082, fragment* (epytype, selected here, NY).

Crataegus frugalis Beadle, Biltmore Bot. Stud. 1:100. 1902. Type: U.S.A. Georgia. Dougherty Co.: along river above Albany, 3 Apr 1901, *C.D. Beadle 4092* (lectotype, here selected, US).

Crataegus recurva Beadle, Biltmore Bot. Stud. 1:106. 1902. Type: U.S.A. Florida. Marion Co.: Ocala, Mar 1901, *C.D. Beadle 4007*^{2} (lectotype, here selected, A).

Crataegus villaris Beadle, Biltmore Bot. Stud. 1:108. 1902. Type: U.S.A. Florida. Marion Co.: Citra, 27 Mar 1901, *C.D. Beadle 4042* (lectotype, selected here: US).

? = *Crataegus adusta* Beadle, Biltmore Bot. Stud. 1:110. 1902. Type: U.S.A. Florida. Alachua Co.: Gainesville, 1901, *C.D. Beadle 4065* (lectotype, selected here: US)

? = *Crataegus incana* Beadle, Biltmore Bot. Stud. 1:113. 1902. Type: U.S.A. Florida. Liberty Co.: Bristol, 24 Aug 1901, *T.G. Harbison 4918* (lectotype, selected here: US). U.S.A. Florida. Liberty Co.: Bristol, 29 Mar 1901, *T.G. Harbison 4020, fragment* (epitype, selected here, NY).

Shrubs or small trees 2–6 m tall; habit quite lacrimate; twigs of the season densely appressed white-pubescent, 1-year old gray-brown to purple-brown; older gray; thorns 1–4 cm long, none to plentiful, straight, ± fine, purple-brown to gray. Leaves deciduous; petioles 2–6 mm long, densely pubescent, glandular at least initially; blades 1–2.5 cm long, narrowly oblong to narrowly oblanceolate or narrow-elliptic or more commonly spatulate in general shape, generally tapered rather fast into a cuneate base, the tip subacute, obtuse or truncate, ± entire or occasionally obscurely lobed; margins gland-dotted when young, occasionally rather obscurely crenate-serrate at the tip; venation craspedodromous with 1–4 narrowly diverging veins per side exiting beyond the widest part of the leaf; conspicuously pubescent along the veins below, slightly so above; often rather densely pubescent at first on the adaxial and slightly pubescent on the abaxial surface, later glabrescent. Inflorescences 1–3-flowered; branches densely appressed- white- pubescent, bearing deciduous, linear, membranous, gland-margined bracteoles. Flowers 16–18 mm diam.; hypanthium externally copiously white-pubescent; calyx-lobes ca. 4 mm long, narrow-triangular, gland-margined, abaxially thinly pubescent; petals elliptic or ± circular, white; stamens 20, anthers cream; styles usually 3. Fruit ca. 8 mm diam., subglobose, glabrescent to somewhat pubescent, yellow to copper-orange or reddish-orange when-ripe; calyx remnants reflexed when present, sometimes circumscissile; nutlets 3, dorsally grooved, laterally smooth.

Distribution.—*Crataegus crocea* ranges from southwestern Alabama to central Florida and through Georgia and South Carolina just into North Carolina (Fig. 10) where it is locally common on sand plains and in open scrubby places. It is particularly abundant in Alachua and Marion Cos., Florida.

Crataegus crocea is somewhat variable and will normally be found annotated as *C.recurva* in my annotations. The form selected as typical actually represents one pole of variation. However, it is the most distinctive compared to other taxa in ser. *Lacrimatae* and is locally common at least in northern Florida. It has narrow-elliptic leaves perfectly smooth in outline, acute at the apex, the distal margins sometimes finely denticulate. Its median leaf shape is similar to the narrowest leaf in the flowering inset. Other forms with similar leaves may be referred to *C. frugalis* and, if with larger leaves at maturity sometimes slightly lobed distally, to *C. recurva. Crataegus curva* has a somewhat similar leaf form with broader and shorter leaves and shorter petioles. Commonly, however, leaves of specimens here referred to *C. crocea* are wider than the type and somewhat spatulate, as illustrated in Fig. 9 - these represent *C. villaris* (which is keyed out). All the foregoing forms intergrade. Forms such as *C. adusta* which have somewhat similar shaped leaves to those of *C. villaris* (both larger in all parts than typical *C. crocea*) and often with strongly crenulate to obscurely lobed leaf apices) are intermediate with *C. condigna*. Finally, other specimens with shorter and broader leaves,

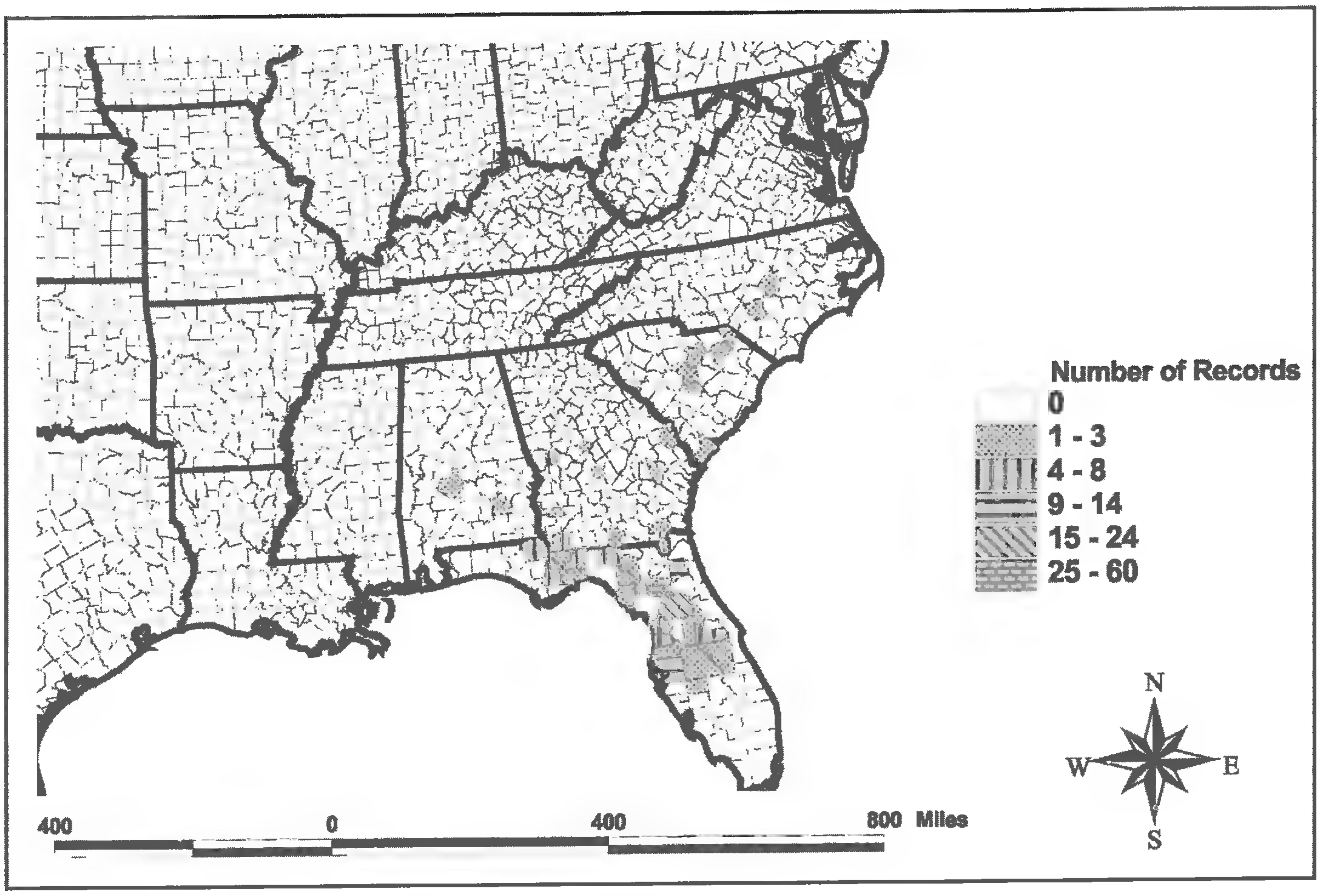

Fig. 10. County level distribution map of *Crataegus crocea*.

rather like those of *C. dapsilis* (ser. *Robustae*), but which retain the typically small fruit of subser. *Tenues* are referred to *C. incana*, a form characterized by a particularly dense tomentum when young.

There should usually be no difficulty separating *C. crocea* from *C. munda* of this subseries and from the small-leaved *C. condigna* of subser. *Robustae*, both of which have prominently toothed leaf margins, nor from *C. lacrimata* with its glabrous inflorescences. Larger-leaved forms of *C. cro cea* with spatulate-cuneate blades and obscurely crenate-serrate apices may resemble the *C. illudens* form of *C. lassa* from Selma, Alabama. *Crataegus crocea*, like many in this subseries, can form an attractive, delicate shrub which should be very suitable for xeriscaping.

5a. Crataegus vicana Beadle, Biltmore Bot. Stud. 1:104. 1902. Type: U.S.A. Florida. Lake Co.: Tavares, 17 Aug 1901, *C.D. Beadle 4010*^{2} (lectotype, selected here: US). U.S.A. Florida. Lake Co.: Tavares, 21 Mar 1901, *C.D. Beadle 4010, fragment* (epytype, selected here, NY).

Comment.—the epitype well displays almost complete lack of lobing on the crenate-margined young leaves as well as inflorescence indumentum.

Crataegus laxa Beadle Biltmore Bot. Stud. 1:103. 1902. Type: U.S.A. Alabama. Russell Co.: Girard, 8 Apr 1901, *C.D. Beadle 4117, fragment* (lectotype, here selected, NY)

? = *Crataegus inopina* Beadle, Biltmore Bot. Stud. 1:107. 1902. Type: U.S.A. Florida. Marion Co.: near Ocala, 20 Aug 1901, *C.D. Beadle 4001*^{2} (lectotype, selected here: US). *Comment.*—The lectotype of *C. inopina* is almost leafless and difficult to interpret but it seems to equate to *C. vicana*. U.S.A. Florida. Marion Co.: near Ocala, 21 Mar 1901, *C.D. Beadle 4001* (epytype, selected here, NY). *Comment.*—This is a clear case where additional material is needed but, even so, the epitype is only a fragment.

Crataegus vicana is somewhat intermediate between *C. crocea* and *C. quaesita* and consists of forms with long-petiolate leaf-blades 2.5–4 cm long (i.e., generally much longer than in *C. crocea*) and length-width ratios of 1.7–1.9:1 that are strongly crenate, especially young, but barely lobed with 0–1 very small subterminal lobes per side. It somewhat resembles in general shape the broader-leaved *C. crocea* types with blunt or cuspidate

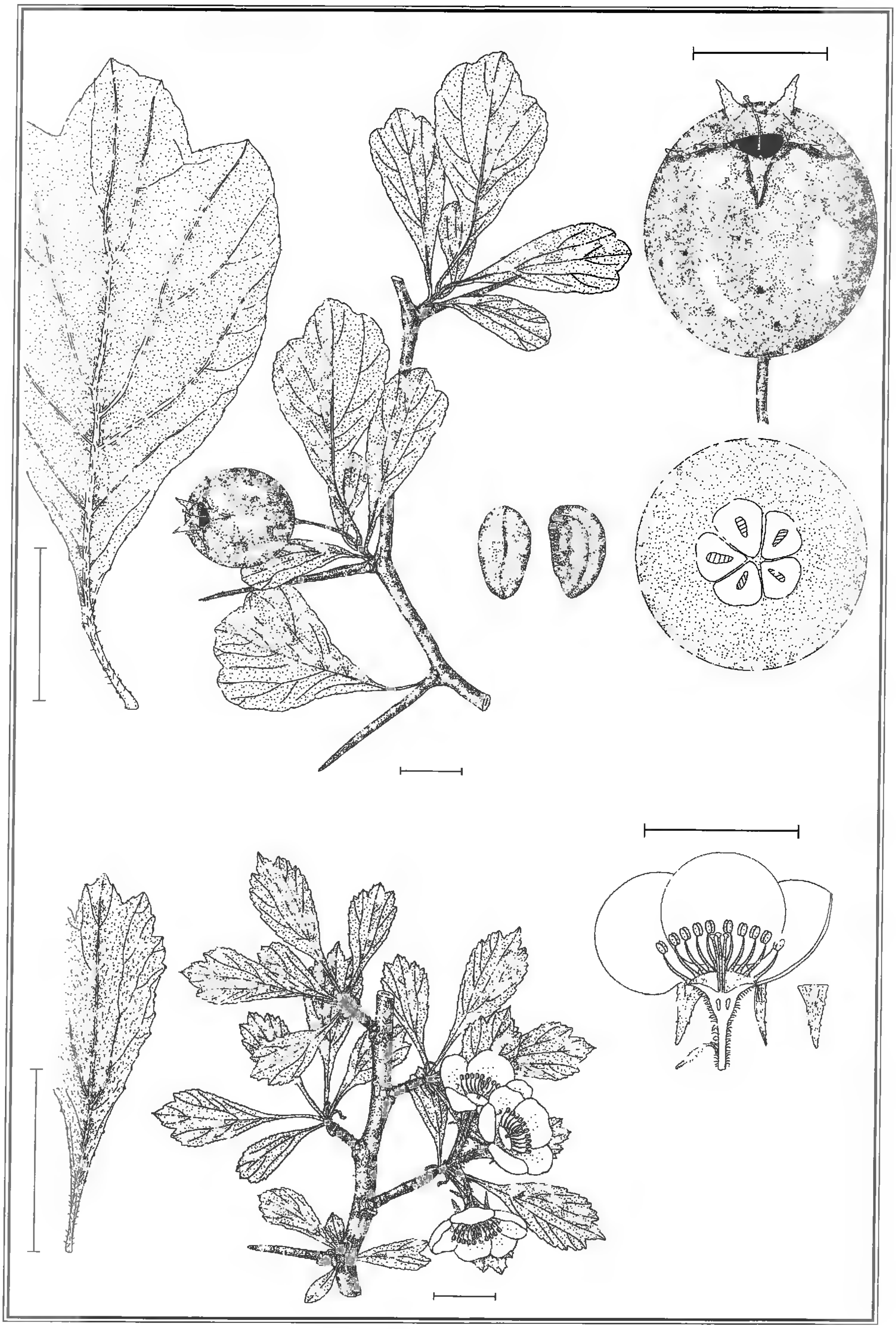

Fig. 11. Line drawings of: *Crataegus quaesita* from *J.B. Phipps 6492* (UWO), flowering; and of *C. floridana* from *J.B. Phipps 6791*, flowering and *R. Lance s.n.* (UWO), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

narrow-obovate leaf-blades. The flowers are ca. 15 mm diam. and the fruit is smallish and pyriform-ellipsoid 6–8 mm diam, yellow or yellowish orange sometimes splotched with red (Beadle).

Distribution.—*Crataegus vicana* is a quite common entity of north-central Florida and Georgia with a single Alabama record.

It may be compared to *C. crocea* (*adusta* form) but usually has a more triangular to obtuse, rather that cuspidate, leaf apex that, in addition, is more irregular, at least at maturity. Also, there are similarities to the slender-leaved forms of the polymorphic *C. condigna.*

6. Crataegus quaesita Beadle, Biltmore Bot. Stud. 1:33. 1901. (**Fig. 11**). Type: U.S.A. Florida. Gadsden Co.: River Junction, 3 Apr 1900, *C.D. Beadle 2080* (lectotype, selected here: US).

Crataegus viaria Beadle, Biltmore Bot. Stud. 1:101. 1902. Type: U.S.A. Florida. Duval Co.: Jacksonville, 29 Mar 1901, *C.D. Beadle 4065* (lectotype, selected here: US).

Crataegus resima Beadle, Biltmore Bot. Stud. 1:100. 1902. Type: U.S.A. Georgia. Dougherty Co.: Albany, no date, *C.D. Beadle 4089²* (lectotype, selected here: NY 435966; isotypes: NY, US). *Comment.*—The NY specimen selected is preferred for lectotype as it also has a flowering stem on the same sheet.

Shrubs or small trees 2–5 m tall; habit lacrimate; twigs of the season ± densely appressed white-pubescent, 1-year old gray-brown to purple-brown; older gray; thorns 1–2 cm long, usually present, straight, ± fine, purple-brown to gray. Leaves deciduous; petioles 2–6 mm long, densely pubescent, glandular at least initially; blades 1.5–3.0 cm long, narrowly broad-cuneate to obtrullate in general shape, generally tapered rather fast into a cuneate base, the tip acute to subacute; 1–2 small sharp lobes per side terminally, occasionally rather obscurely crenate-serrate at the tip; margins gland-dotted when young; venation craspedodromous with 1–4 narrowly diverging veins per side exiting beyond the widest part of the leaf; conspicuously pubescent along the veins below, slightly so above; often rather densely pubescent at first on the adaxial and slightly pubescent on the abaxial surface, later glabrescent, somewhat stiff or ± floppy at maturity. Inflorescences 1–3(–4)-flowered; branches densely appressed- white-pubescent, bearing deciduous, linear, membranous, gland-margined bracteoles. Flowers 10–13 mm diam.; hypanthium externally white-pubescent; calyx-lobes ca. 4 mm long, narrow-triangular, gland-margined, abaxially thinly pubescent; petals elliptic or ± circular, white; stamens 20, anthers cream (?purple, see comment); styles usually 3–4. Fruit ca. 8–10 mm diam., subglobose, glabrescent to pubescent, mainly reddish-orange to red when-ripe; calyx remnants not always present, reflexed when so; nutlets 3–4(–5), dorsally grooved, laterally smooth.

Distribution (Fig. 12).—Northeastern Florida and Georgia, sandy soils.

Beadle's protologue for *C. quaesita* claims the anthers are purple, but if so, this would be nearly the only instance in ser. *Lacrimatae*, which series it fits in all other respects. The leaves of this species are somewhat like a very elongated *C. egens,* especially in its *viaria* form. *Crataegus resima* and *C. viaria* are good matches for *C. quaesita*, although the *viaria* form has less sharp lobes than the type form. *Crataegus meridiana* (subser. *Robustae*) is rather similar but more robust and with larger flowers.

6a. Crataegus sp. aff. **resima** Beadle, Biltmore Bot. Stud. 1:100. 1902. (**Fig. 14**).

This is a very local species with some similarities to *C. quaesita*. The mature, expanded leaves, 2–3 cm long, are however, much more sharply lobed and very sharp-tipped. Moreover, at anthesis these leaves are particularly small, only ca. 1 cm. long and thus very little expanded whereas in C. *quaesita* the leaves are nearly full size then. The flowers are 10–12 mm diam., the plant is very thorny, and the extension shoot leaves are 3 cm wide, ± isodiametric in general shape, with deep, narrow sinuses presenting a *marshallii*-like appearance.

Distribution.—Most specimens are from near Jacksonville, Florida but several are from Georgia.

7. Crataegus floridana Sarg., Bot. Gaz. 33:124. Feb 1902. (**Fig. 11**). Type: U.S.A. Florida. Duval Co.: Jacksonville, 18 Jul no year, *A.H. Curtiss 8* (lectotype, selected here: A). *Comment.*—i) collection number was added to the lectotype label later in pencil; ii) another sheet from A, also labeled "TYPE" and containing presumptive lectotype material, is *A.H. Curtiss s.n.*, Mar 25 1900, same locality; this has five specimens, the central ones with much more sharply pointed tips, probably from another plant and perhaps repesenting a different taxon and its left-hand specimen would make an excellent epitype were one needed.

Crataegus anisophylla Beadle, Biltmore Bot. Stud. 1:99. Apr 1902. Type: U.S.A. Florida. Duval Co.: Jacksonville, 30 Mar 1901, *C.D. Beadle 4067* (lectotype, selected here: NY; isotype: US).

Crataegus versuta Beadle, Biltmore Bot. Stud. 1:112. Apr 1902. Type: U.S.A. Georgia. Dougherty Co.: Albany, 25 Aug 1901, *C.D. Beadle 4091²* (lectotype, selected here: US). *Comment.*—This is a somewhat less markedly lobed form.

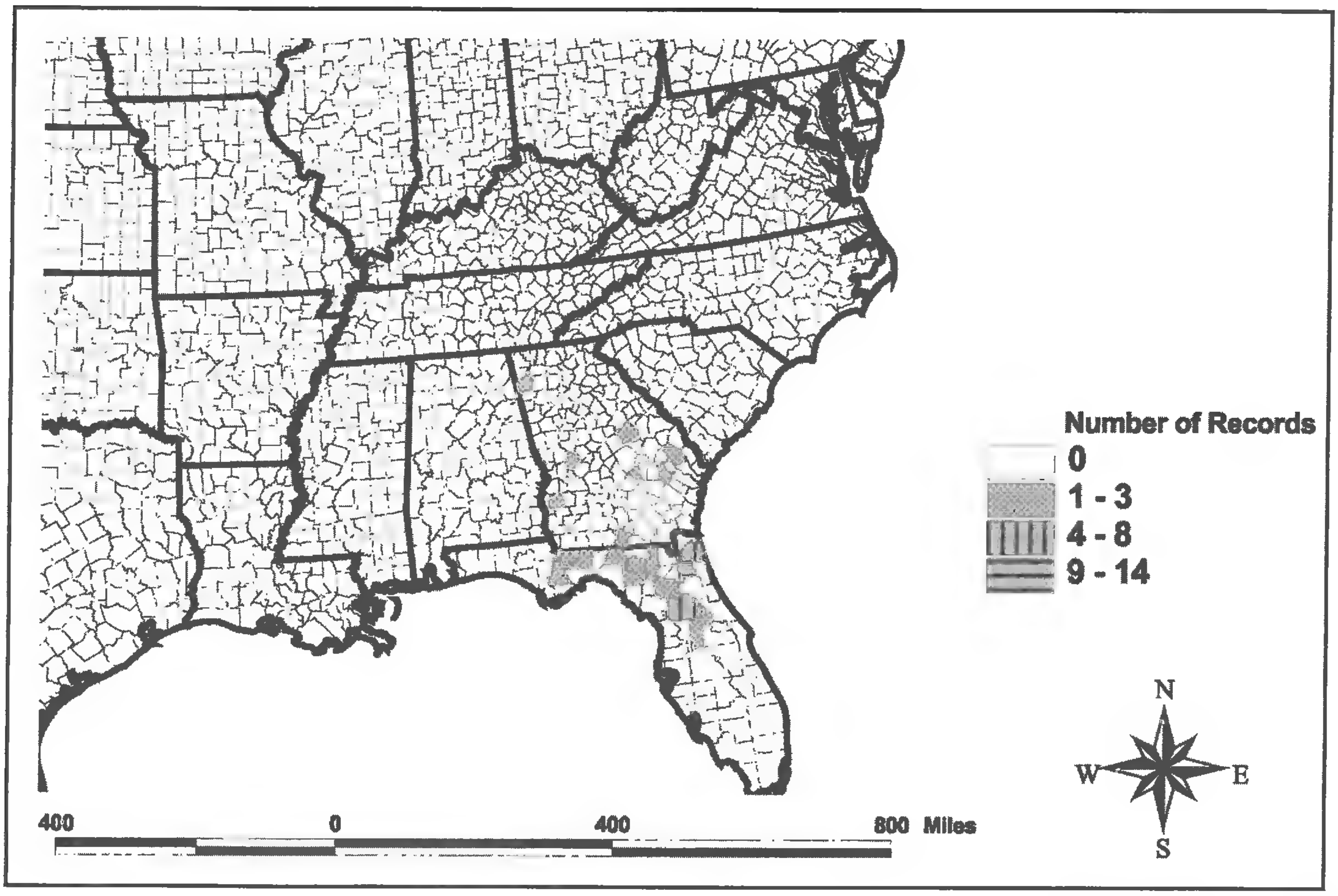

Fig. 12. County level distribution map of *Crataegus quaesita*.

Shrub to 6 m tall; bark of trunk dark brown or rimose; branches drooping; ultimate twigs zig-zag, dark purple-brown at 2 yrs; thorns fine, 2 cm long; dark purple-brown at 2 yrs. Leaves deciduous; petioles slender, 1–2 cm long, blades 1.5– 4.0 cm long, spatulate to obtrullate in general outline, somewhat obscurely to ± distinctly and subacutely lobed in the apical region; margins crenate to serrate in apical region, margins smooth proximally, strongly gland-dotted young; venation craspedodromous, main lateral veins 2–3/side; ± pubescent on both surfaces, persistent. Inflorescences 2–4-flowered; branches canescent-tomentose, bearing deciduous, linear, membranous, gland-margined bracteoles. Flowers 12–15 mm wide; hypanthium tomentose; calyx-lobes narrowly triangular, abaxially tomentose; margins ± entire, petals 5, ± circular, white; stamens 20, anthers cream; styles 3–5. Fruit ellipsoid to subspherical, 6–8 mm diam., subglabrous or with some residual pubescence, orange; nutlets 3–5, dorsally grooved.

Distribution (Fig. 13).—*Crataegus floridana* is found in northern Florida, particularly around Jacksonville, and extends into Georgia with single records from Kershaw Co., South Carolina and Brunswick Co., North Carolina. It occurs on dry ground.

The delicate, long-petiolate leaves of *Crataegus floridana* may often be observed fluttering in the wind. Typical material of this species has long-petiolate leaves much longer than wide that are flared above the petiole and with shortish but somewhat acute lobes across the distal end. There is a gradation on the one hand to leaf forms with similar proportions but obscure or blunt lobes and on the other to forms with rather deep (LII 20–25%) and sharp lobes where the length:width ratio is as low as about 1.25. *Crataegus floridana* normally has the largest leaves of the *Tenues* group but has all the group characteristics of very short thorns, thin leaves, fine, very pendulous twigs, etc. The lectotype of *C. floridana*, with its trilobed leaves, is an exact match for the illustration of fruiting material of the latter species (Sargent, Silva, 1890, t.189). Sources of plentiful later confusion were that Sargent (1890) mistakenly placed *C. floridana* under *C. flava* (see explanation under *C. floridana* in vol. 13 of the same work (Sargent 1902)) and that the illustration

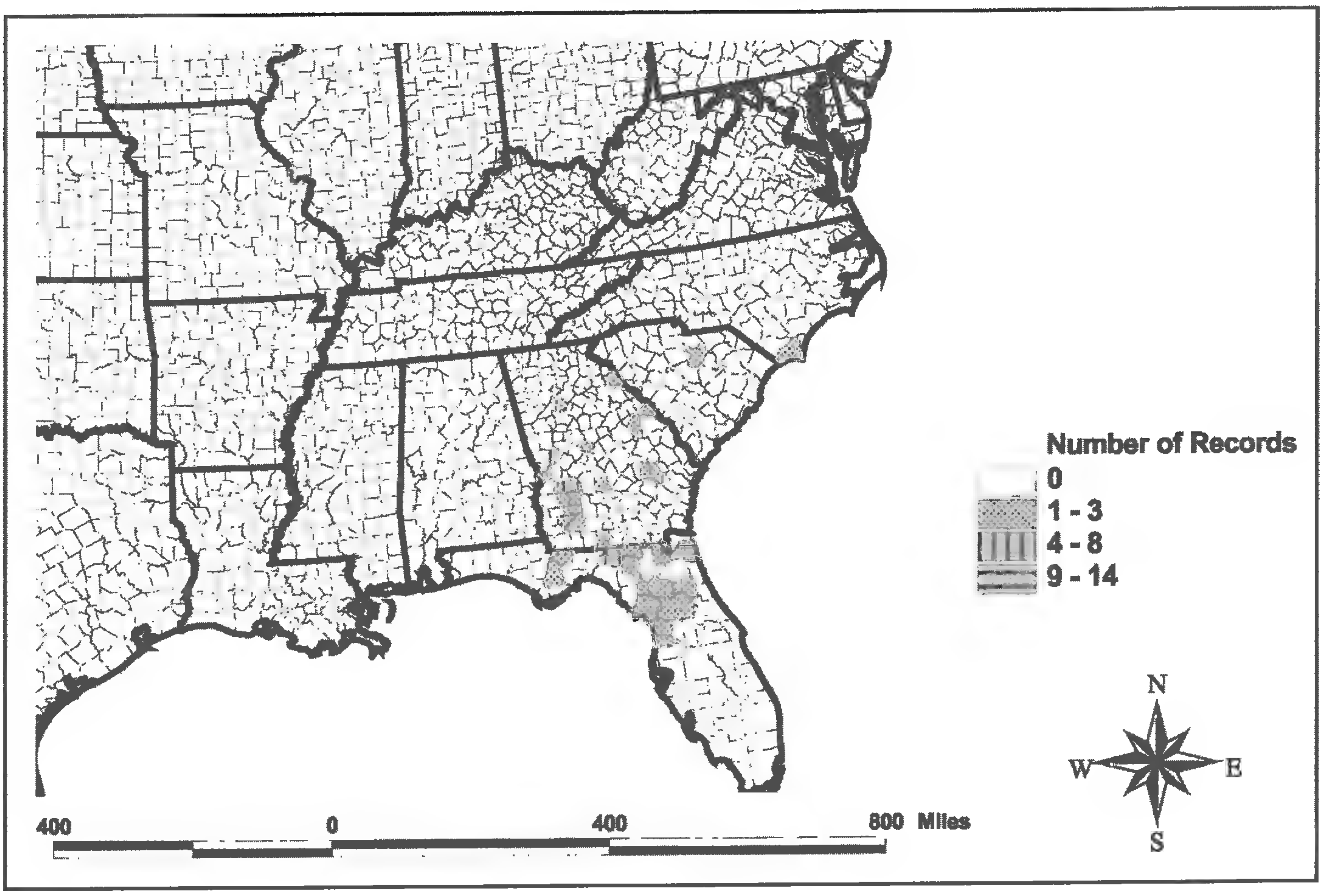

Fig. 13. County level distribution map of *Crataegus floridana*.

cited in Sargent (1890) clearly shows a different species, perhaps *C. crocea*. *Crataegus anisophylla* is a name that may be applied to the more markedly lobed forms. Much of the material of *C. floridana* was annotated *C. anisophylla* by me before the type of *C. floridana* was located. Also note comments under *C. meridiana*.

8. Crataegus invicta Beadle, Biltmore Bot. Stud. 1:37 1901. Type: U.S.A. Georgia. Wayne Co.: Doctortown, no date, fruiting specimen, no collector or number (lectotype, selected here: US 969331).

Small shrub 1–2.5 m tall, slender; branches flexuous at the nodes, extending shoots dense-canescent, rapidly becoming dark below the indumentum, purple-brown at 1-year old; usually very thorny, thorns 3–5 cm long, fine, straight, dark purple-brown at 1yr, becoming gray. Leaves deciduous; petioles 1–3 mm long, pubescent, gland-margined; blades 1.5–2 cm long, obovate-cuneate in general shape, shallowly lobed in the apical part, obscurely so in narrower or smaller leaves; margins obscurely crenate or crenato-serrate, teeth glandular; venation craspedodromous, veins 1–3 per side, exiting at or beyond at the widest part; surfaces in late spring to early summer moderately densely covered with a crisped pubescence; very glossy (probably dark green) adaxially at maturity. Inflorescences 1–2(–3)-flowered; branches very dense white-pubescent, bearing a few small, semi-persistent, linear, gland-margined bracteoles. Flowers 12–15 mm diam.; hypanthium externally ± densely pubescent; calyx-lobes narrow-triangular, abaxially thinly, margins glandular-serrate; petals ± circular, white; stamens 20, anther colour unknown; styles 3–5. Fruit 6–8 mm diam. by mid-June, ± pyriform, fully ripe fruit not recorded.

Distribution.—Dry sandy soils, southeastern Georgia and adjacent South Carolina, scarce and local.

Crataegus invicta is a distinctive species capable of flowering at under 1.5 m tall, as in the type collection. It is somewhat similar to the *cirrata* form of *C. egens* but differs in its relatively shorter petioles, typically much more thorny habit, and blunter and more shiny, apparently more coriaceous, foliage in the little material seen.

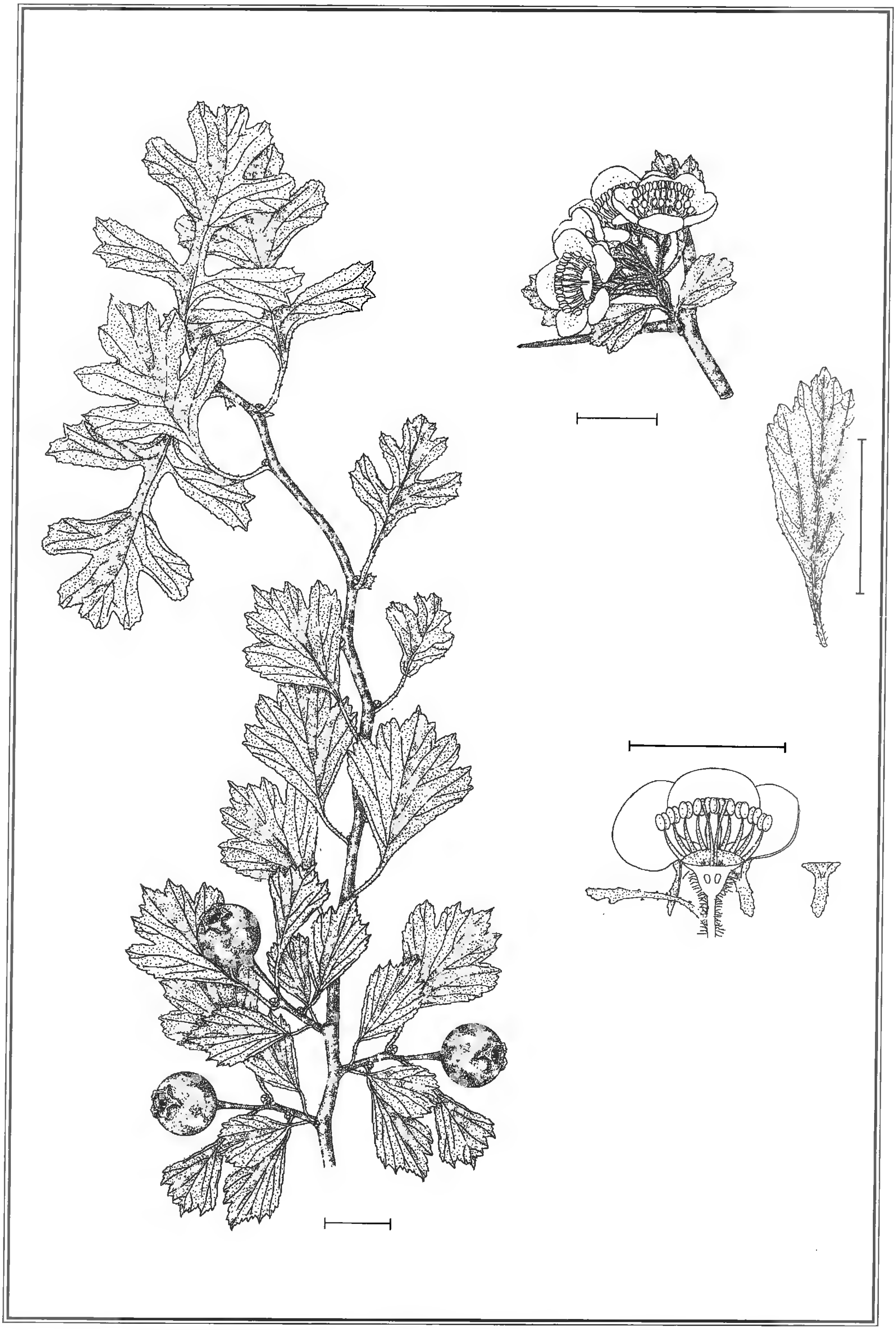

Fig. 14. Line drawing of *Crataegus* sp. aff. *C. resima* from *Curtiss 811* (NY), flowering and fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

8a. Crataegus sp.

This is a typical subser. *Tenues* shrub with strongly lacrimate branches, short, fine thorns and narrowly rhombobovate leaf-blades, i.e., with the lateral vertices nearer the distal end and entire margins; the long-cuneate bases taper into the pedicels which are 50–75% the length of the blades; flower diameter is 12–16 mm; styles 2–4; fruit pyriform, 7–12 mm diam., orange, usually flushed red.

This is a local form with a very distinctive leaf shape that does not appear to match any named entity, is probably not described and would key out next to *C. crocea*. It is known from northern Florida is very distinctive.

Subseries **Robustae** J.B. Phipps, subser. nov. (spp. 9–21). Type Species: *C. furtiva* Beadle.

Habitus vulgo aliquantum robustus et validus cum ramulis ultimis vulgo ± pendulis in plantis maturis; ramuli crassiores, saepe 2–3 mm lati ca. 5 cm ab apice; spinae, si adsunt, 2–5 cm longae, vulgo aliquantum valdae; laminae saepe 2.5–4 cm longae, et tremofactae in vento levissimo solum in *C. lanata* et *C. lassa*; fructus vulgo grandiores, 8–12 mm diam., saepe cuprini in maturitate.

Habit relatively robust and stocky though ultimate twigs usually ± pendulous in mature specimens; twigs thicker, often 2–3 mm wide at about 5 cm from the tip; thorns, if present, normally relatively stout, 2–5 cm long; blades commonly 2.5–4.0 cm long, often rather thick and stiff, fluttering in a light wind only in *C. lanata* and *C. lassa*; fruit usually larger, 8–12 mm diam., often copper-colored at maturity.

Members of this subseries also characteristically have thicker and often larger leaves than in subser. *Tenues* although this is not true of *C. condigna* and some forms of *C. integra*.

9. Crataegus condigna Beadle, Biltmore Bot. Stud. 1:35 1901. (**Fig. 15**). Type: U.S.A. Florida. Gadsden Co.: River Junction, 5 Sep 1899, *C.D. Beadle 1095* (lectotype, selected here: US).

Crataegus ravenelii Sargent, Bot. Gaz. 33:122. Feb 1902. Type: U.S.A. Georgia: Augusta, sand hills, 1901, *A. Cuthbert 411* (lectotype, here designated, A). *Comment.*—Ravenel's specimens from Aiken, SC, mentioned by Sargent and which might have included preferable lectotypes, have not been located. The lectotype, without precise date, is in full flower.

Crataegus arguta Beadle, Biltmore Bot. Stud. 1:102. Apr 1902. Type: U.S.A. Alabama. Russell Co.: Girard, 9 Apr 1901, *C.D. Beadle 4123* (lectotype, selected here: US).

? = *Crataegus audens* Beadle, Biltmore Bot. Stud. 1:114. Apr 1902. Type: U.S.A. Florida. Gadsden Co.: Chattahoochee, 30 Aug 1901, *T.G. Harbison 4963* (lectotype, selected here: US). U.S.A. Florida. Gadsden Co.: Chattahoochee, 8 Apr 1901, *T.G. Harbison 4097* (epytype, selected here, US).

Crataegus clara Beadle, Biltmore Bot. Stud. 1:95. Apr 1902. Type: U.S.A. Florida. Liberty Co.: Bristol, 4 Apr 1901, *T.G. Harbison 6033* (lectotype, selected here: NY).

Crataegus compitalis Beadle, Biltmore Bot. Stud. 1:93. Apr 1902. Type: U.S.A. Florida. Alachua Co.: Gainesville, 22 Aug 1901, *C.D. Beadle 4060*^{2} (lectotype, selected here: US). *Comment.*—A flowering syntype at NY (*Beadle 4060*) appears to represent a different species, perhaps *C. illudens*.

Crataegus insidiosa Beadle, Biltmore Bot. Stud. 1:94. Apr 1902. Type: U.S.A. Alabama. Dale Co.: Ozark, 11 Apr 1901, *T.G. Harbison 4115* (lectotype, selected here: NY). *Comments.*—The lectotype is wrongly attributed to W.W. Eggleston and seems indistinguishable from *C. clara*.

?= *Crataegus rava* Beadle, Biltmore Bot. Stud. 1:91. Apr 1902. Type: U.S.A. Florida. Leon Co.: Tallahassee, no date, *T.G. Harbison 4064* (lectotype, selected here: US).

C. rimosa Beadle, Biltmore Bot. Stud. 1:107 Apr 1902. TYPE: U.S.A. Florida. Marion Co.: Citra, 21 Aug 1901, *C.D. Beadle 4043*^{2} (lectotype, selected here: US 981163). U.S.A. Florida. Marion Co.: Citra, 27 Mar 1901, *C.D. Beadle 4043* (epytype, selected here: NY).

? = *Crataegus alachuaniformis* Murrill, Castanea 7:21. 1942. U.S.A. Florida. Alachua Co.: Sugarfoot, Aug 27 1940, *W.A. Murrill 34276* (lectotype: FLAS; isotype: US).

? = *C. praeformosa* Murrill, Castanea 7:25. 1942. U.S.A. Florida. Alachua Co.: 2 mi S of Warren's Cave, 10 Sep 1940, *W.A. Murrill 34618* (lectotype: FLAS; isotype: US).

Intricate shrub, 1–2.5 m tall or large shrub or small tree to 3–6 m tall (–10 m in the type); branchlets flexuous; extending twigs densely appressed-pubescent; 1-year old purple-brown; older dark gray; usually thorny, 2-year old thorns (2) 3–4 cm long, ± straight, rather fine, blackish gray. Leaves deciduous; petioles 5–8 mm long, ca. 20–35% length of blade, dense-pubescent, glandular; blades usually 1.5–3.0 cm long, obovate-spatulate in general outline; base tapered into petiole, apex often cuspidate, subacute to acute; unlobed or with the merest hint of lobes across the distal portion; margins evenly and distinctly dentate to

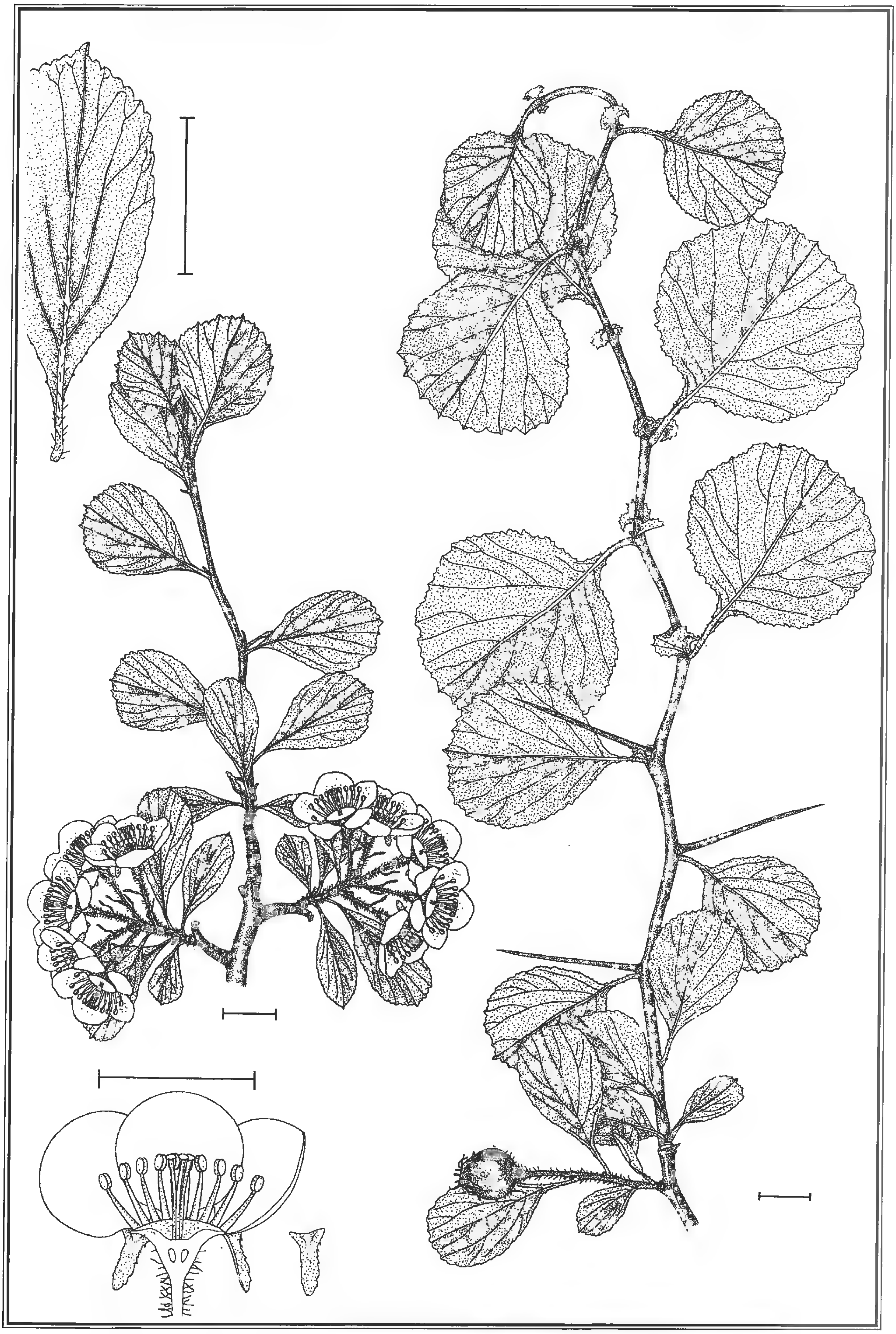

Fig. 15. Line drawing of *Crataegus condigna* from *J.B. Phipps 6578* (UWO), flowering and *R.K. Godfrey 80642* (UWO), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

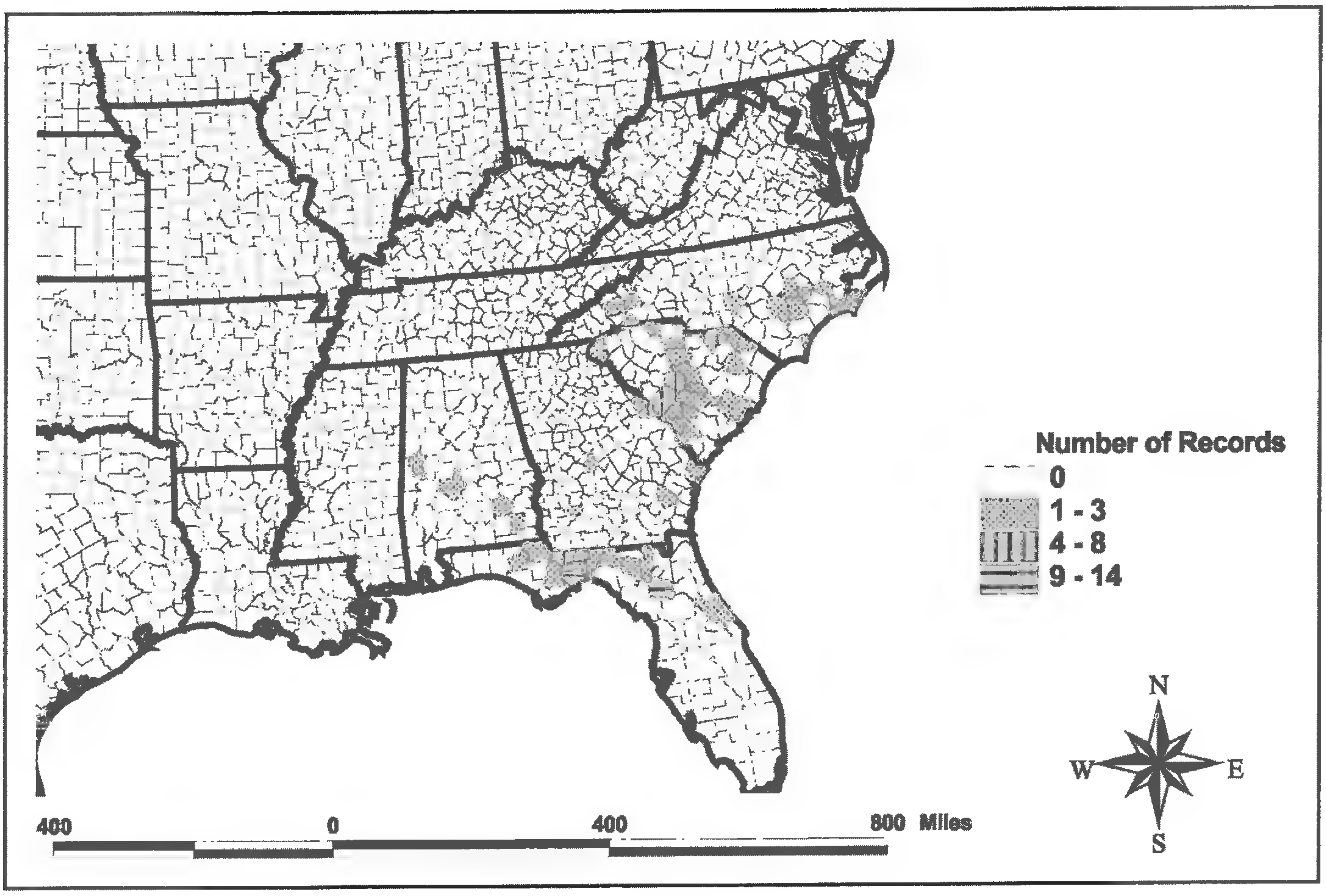

FIG. 16. County level distribution map of *Crataegus condigna*.

crenate-serrate, the teeth gland-tipped; venation craspedodromous, 3–4 veins per side exiting in the distal part of the leaf; at first pubescent above, below scabrous-hairy on the surface and tomentose on the main veins; bright light green young, coriaceous and somewhat shiny at maturity. Inflorescences 2–4-flowered; branches densely appressed-pubescent, bearing deciduous, linear, membranous, gland-margined bracteoles. Flowers 13–16 mm diam.; hypanthium externally white-canescent, less densely above; calyx-lobes 3 mm long, narrow-triangular, margins gland-toothed, pubescent abaxially; petals ± circular, white; stamens 20, anthers cream; styles 3–5. Fruit 9–12 mm high, subglobose to sometimes ellipsoid, orange-red or orange at maturity, sometimes with flushed cheeks; calyx-lobes reflexed; nutlets 3–5, dorsally grooved, sides plane.

Distribution (Fig. 16).—*Crataegus condigna* has numerous records from south-central Alabama, North and South Carolina, as well as from Georgia and northern Florida. It is found in open areas and thin woodland, usually on sandy soil where it can be quite common.

This is an abundant and variable species, characterized by unlobed but distinctly toothed leaf margins. The extreme variation in stature suggests the existence of at least two forms but in the herbarium they cannot be distinguished. Forms with smaller leaves and more delicate branching, e.g., typical *C. condigna*, represent something of a link to subser. *Tenues*, and a few might just key out to to a broad-leaved form of *C. crocea*. On the other hand, forms of *C. condigna* well-developed leaves may resemble narrower versions of those of *C. florens* (but with smaller leaf marginal teeth) and, like the latter, *C.condigna* may also have circular extension-shoot leaves. However, the indumentum of both inflorescence and leaves is quite different from *C. florens*. The typical form is small-leaved, *C. compitalis* represents a particularly large-leaved form, while *C. clara* is a common and average form.

10. Crataegus alabamensis Beadle, Bot. Gaz. 30:342. 1900. (**Fig. 17**). TYPE: U.S.A. ALABAMA. Montgomery Co.: Montgomery, 16 Apr 1900, *C.D. Beadle 2168* (LECTOTYPE, selected here: A).

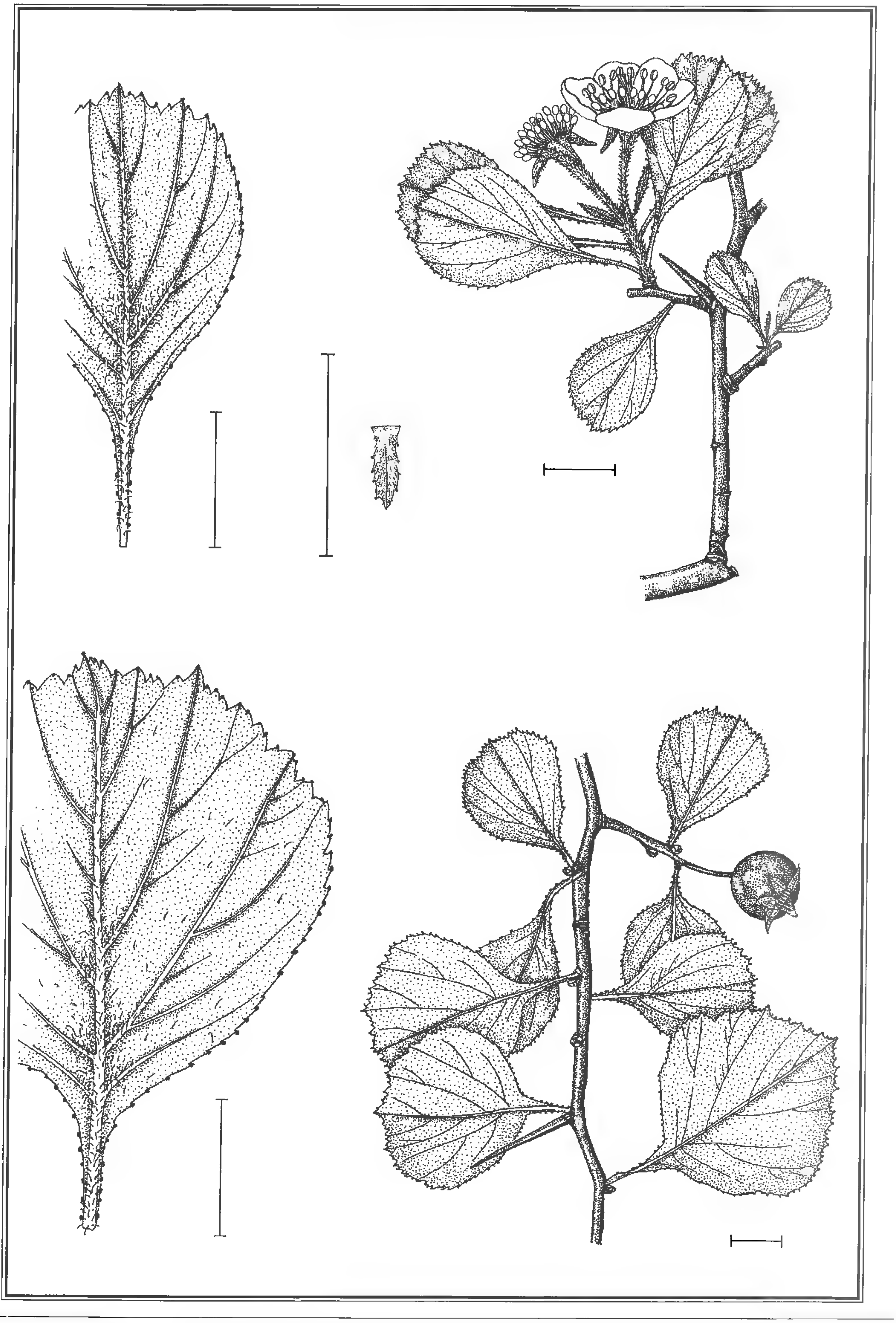

Fig. 17. Line drawing of *Crataegus alabamensis* from *L.C. Anderson 4133* (FLAS), flowering and *R. Kral 31417* (VDB), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

? = *Crataegus adunca* Beadle, Biltmore Bot. Stud. 1:87. 1902. Type: U.S.A. Florida. Leon Co.: Tallahassee, 28 Aug 1901, *T.G. Harbison 4941* (lectotype, selected here: US).

? = *Crataegus dapsilis* Beadle, Biltmore Bot. Stud. 1:89. 1902. Type: U.S.A. Florida. Lake Co.: Lane Park, near Tavares, 17 Aug 1901, *C.D. Beadle 4836* (lectotype, selected here: US).

Shrubs or small trees to 5 or 6 m tall; ultimate branches somewhat pendulous, extending twigs densely tomentose, 1-year old twigs dark gray, older gray; thorns 2–3 cm long, generally sparse or even lacking, slender, ± recurved, dark blackish grey at 1 year. Leaves deciduous; petioles slender, 20–30% length of blade or even shorter, pubescent, glandular; blades 2–3 cm long at anthesis, a little larger at maturity, broad oblong-cuneate in general shape with tip flattened to slightly cuspidate; sides lacking lobes, tapered regularly; margins regularly and finely crenato-serrate, this sometimes nearly or completely disappearing towards the base; venation craspedodromous with 3–5 lateral veins per side; when young surfaces subglabrous above, pubescent only on the veins below, shiny above at maturity. Inflorescences 3–6-flowered; branches tomentose, bearing deciduous, linear, membranous, gland-margined bracteoles. Flowers 20–25 mm diam.; hypanthium externally tomentose; calyx-lobes narrowly triangular, abaxially appressed white-pubescent in the centre of their laminas, edges subglabrous, margins with gland-tipped teeth; petals ± circular, white; stamens 20, anthers yellow; styles 3–5. Fruit 10–15 mm diam., subglobose to pyriform, glabrate, red at maturity, often very glaucous on drying; calyx-lobes spreading; nutlets 3–5, dorsally grooved, sides plane.

Distribution.—Generally scarce, *C. alabamensis* occurs in south central Alabama and northern Florida near Tallahassee. It is found in open woods. The type location is recorded as being on on clay soil near Montgomery, Alabama, a somewhat unusual habitat for this series.

Crataegus alabamensis may be recognized by its beautifully formed leaves with conspicuously, if finely, crenato-serrate margins and, in the type, unusually broad leaves for this general shape (none narrower than 1.6:1). It may be confused with larger forms of the variable *C.condigna*, but see the key. *Crataegus adunca* has, unusually for this series, violet anthers. *Crataegus dapsilis* is a small-leaved form rather like broad-leaved forms of *C. crocea.*

11. Crataegus integra (Nash) Beadle, Biltmore Bot. Stud. 1:87. 1902. (**Fig. 18**). *Crataegus flava* Aiton var. *integra* Nash, Bull. Torrey Bot. Club 22:150 1895. Type: U.S.A. Florida. Lake Co.: vicinity of Eustis, 1–15 Jul 1894, *G.V. Nash 1142* (lectotype, selected here: A; isotype: US).

? = *Crataegus constans* Beadle, Biltmore Bot. Stud. 1:88. 1902. Type: U.S.A. Mississippi. Lowndes Co.: Columbus, 14 Sep 1901, *T.G. Harbison 5066 = 4187*^{2} (lectotype, selected here: US). U.S.A. Mississippi. Lowndes Co.: Columbus, 25 Apr 1901, *T.G. Harbison 4187* (epytype, selected here, NY).

Crataegus dolosa Beadle, Biltmore Bot. Stud. 1:90. 1902. Type: U.S.A. Alabama. Henry Co.: Abbeville, 9 Sep 1901, *T.G. Harbison 5036* (lectotype, selected here: US).

Crataegus sodalis Beadle, 1:80. 1902. Type: U.S.A. Alabama. Russell Co.: Girard, 26 Aug 1901, *C.D. Beadle 4868* (lectotype, selected here: US).

Shrub or small tree 2–5 m tall; bark of trunk ashy gray, rough or scaly; ultimate branches ± pendulous; twigs at 1 yr old ± flexuous, purple-brown or blackish, older dark gray; extending twigs densely white-canescent; usually thornless, or rare thorns 2–3 cm long, these slightly recurved, blackish or purple-brown at 1 yr old. Leaves deciduous; petioles short, usually < 25% length of blade, densely pubescent; blades white-hairy at anthesis, particularly on the veins below; 1.5–4 cm long, obovate-cuneate to narrow-obovate in general shape, the tip generally ± acute, essentially entire else with somewhat obscure, wavy lobes; sides gradually tapered into the winged upper part of the petiole; margins glandular-denticulate to subentire; ± pubescent above and below when young, especially on the veins below, glabrescent; venation craspedodromous, 2–4(–5) lateral veins per side on all but small leaves; ± coriaceous. Inflorescences 2–4-flowered; branches tomentose, bearing deciduous, oblong-linear, membranous, gland-bordered bracteoles; flowering mid-March (Florida) to mid-April. Flowers 15–20 mm wide; hypanthium externally tomentose; calyx-lobes 4 mm long, narrow-triangular, abaxially ± tomentose, margins finely toothed, teeth glandular; petals ± circular, white; stamens 20, anthers cream or ivory; styles 3–5. Fruit typically (8–)10–12 mm diam., subglobose, yellow blushed red to orange-red, pubescent; calyx-lobes spreading; nutlets 3–5, dorsally grooved, sides plane.

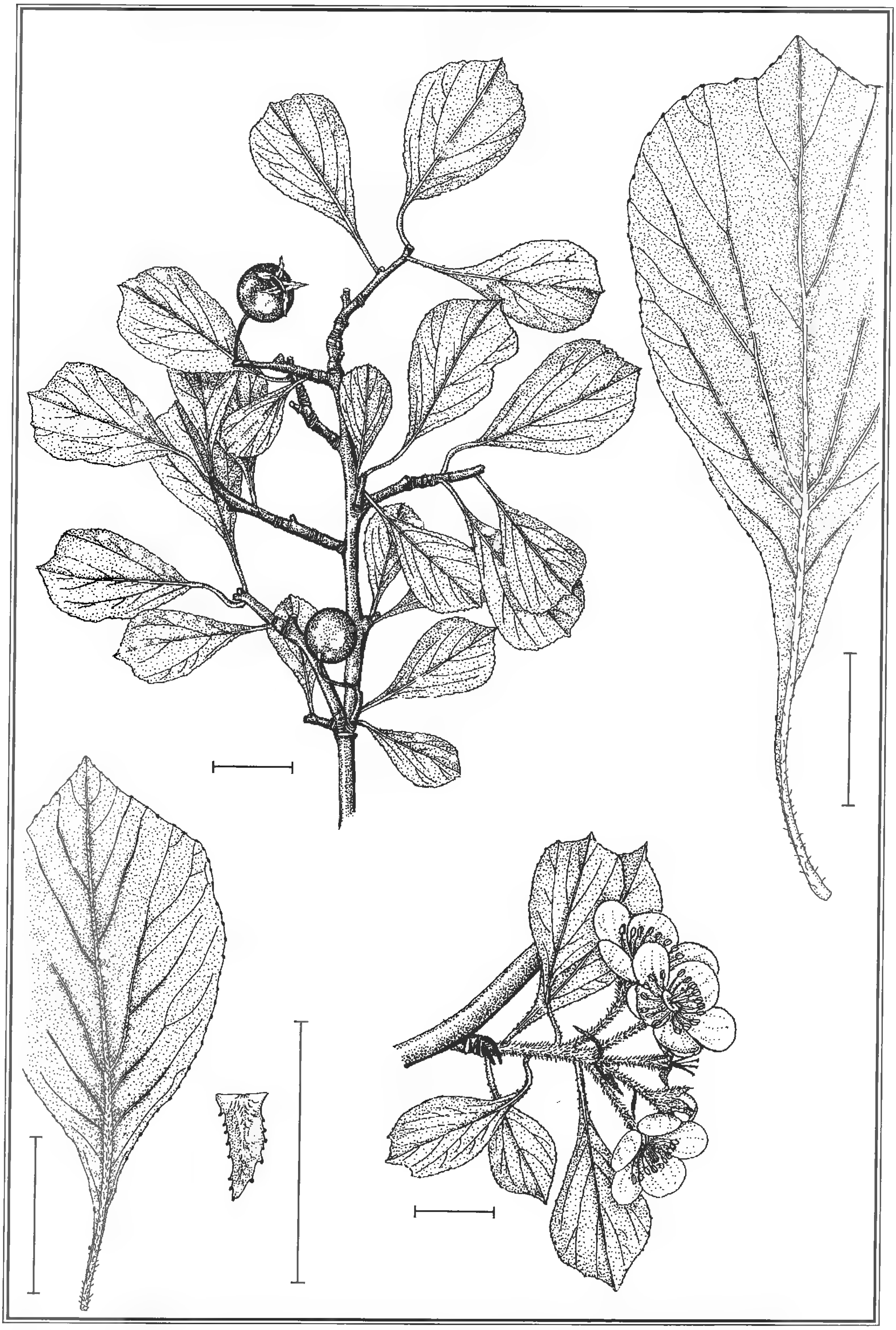

Fig. 18. Line drawing of *Crataegus integra* from *J.B. Phipps* 6650 (UWO), flowering and *R. Lance 2195* (UWO), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

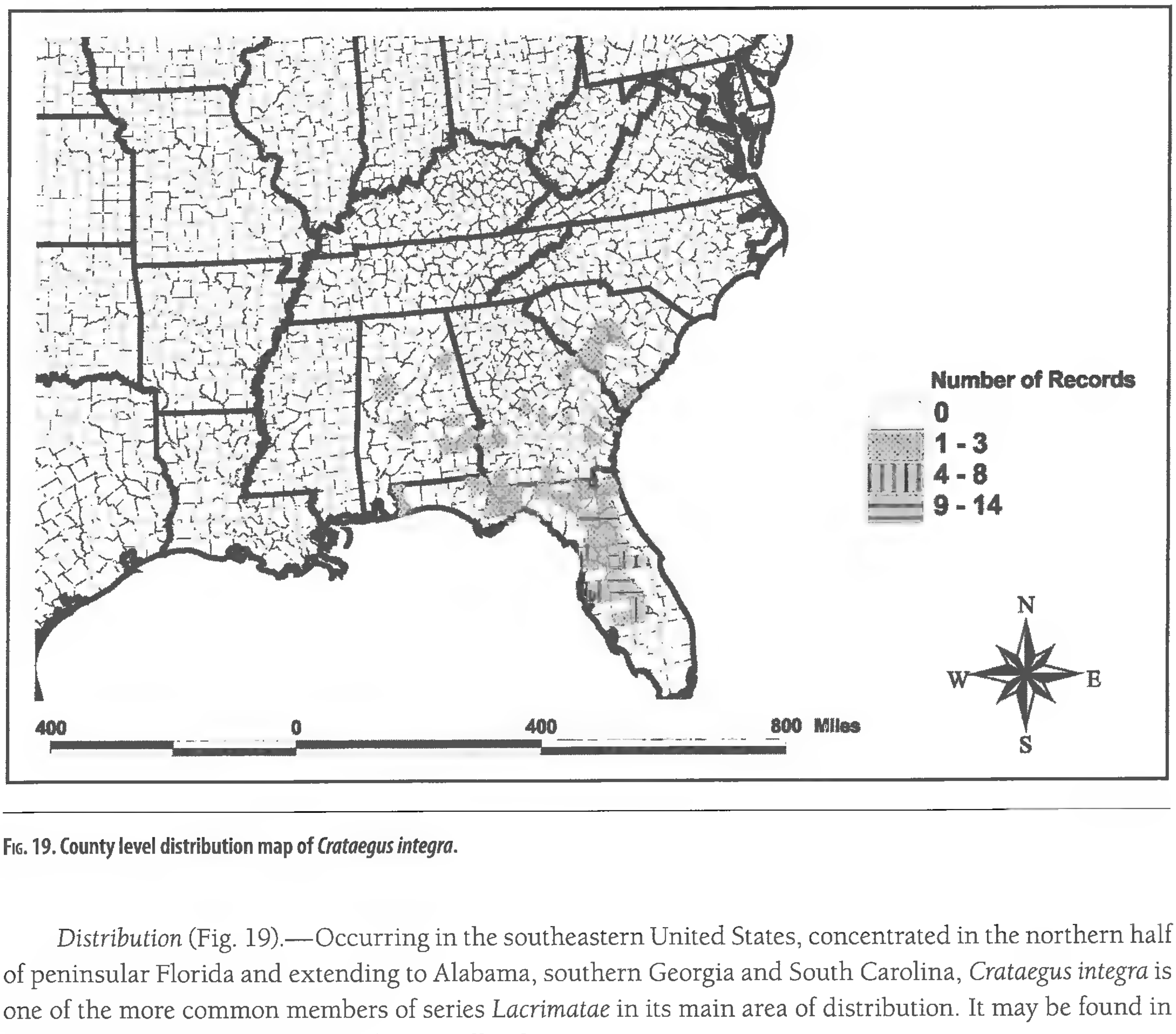

Fig. 19. County level distribution map of *Crataegus integra*.

Distribution (Fig. 19).—Occurring in the southeastern United States, concentrated in the northern half of peninsular Florida and extending to Alabama, southern Georgia and South Carolina, *Crataegus integra* is one of the more common members of series *Lacrimatae* in its main area of distribution. It may be found in sand plains, dry scrubby places, thin woodland, etc.

Crataegus integra is a fairly variable species in leaf shape and is notable for its almost perfectly entire leaf-blades, the margins of which often have numerous, barely detectible leaf-teeth. In well-presented specimens this species frequently displays a considerable variety of leaf size even on one short shoot. It has more veiny leaves than most species of ser. *Lacrimatae* and for this reason might key out to ser. *Apricae*. However, all other characteristics place it squarely with ser. *Lacrimatae*. One of the most different entities in the *C. integra* complex is *C. sodalis* (= *C. dolosa*). This entity has clearly denticulate margins and rather large suborbiculate extension shoot leaves. *Crataegus integra* differs from the *illudens* form of *C. lassa* in its generally rather smaller leaves and lacks the distinctive cuneate-cuspidate shape of the latter species which are also sometimes obscurely subterminally lobed. *Crataegus integra* is particularly common in the northern half of peninsular Florida where *C. lassa* is rare. *Crataegus constans*, with less copious inflorescence tomentum, longer petioles, and proportionately larger and thinner leaves is perhaps a shade form of *C. integra*.

12. Crataegus colonica Beadle, Biltmore Bot. Stud. 1:104. 1902. **(Fig. 20)**. Type: U.S.A. South Carolina. Beaufort Co.: Bluffton, Jun 1882, *J.H. Mellichamp s.n.* (neotype, selected here, A).

Comment.—Beadle says in the protologue that Mellichamp first collected this species at Bluffton in 1882. There are three potential types at A: a flowering specimen ("rec'd May 7 1901"), a fruiting specimen ("rec'd 18 Jul 1899") and a sterile specimen (above), all by Mellichamp from the type locality but in different years. The neotype has attached to it an Arnold Arboretum packet of fruit labeled "SL 897. *C. colonica* Beadle. Type trees. B6007" which implies, but does not prove, that this Mellichamp 1882 specimen is a lectotype. The packaged seed with the neotype is fully mature, incompatible with a received Jun specimen, so it constitutes a separate specimen. I decided that it would be best, therefore, to select as neotype the 1882 Mellichamp specimen from the type locality even

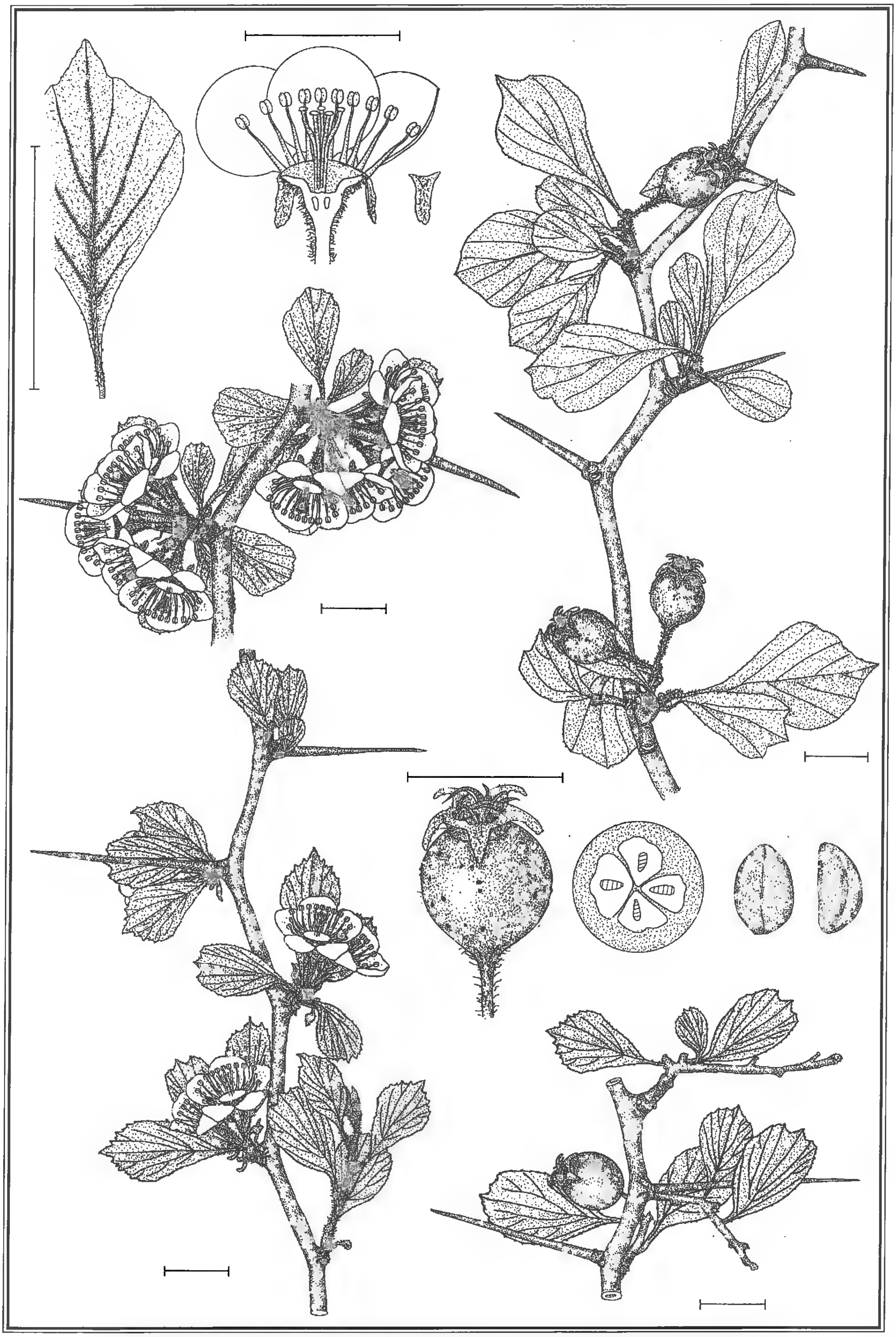

Fig. 20. Line drawings of: *C. colonica* (at top) from *J.B. Phipps 6511* (UWO), flowering and *J.B. Phipps 6671 & 6765* (UWO), fruiting; and *C. pexa* (at bottom) from *J.B. Phipps 6502 & 6576* (UWO), flowering and *Biltmore Herb. s.n.* (US), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

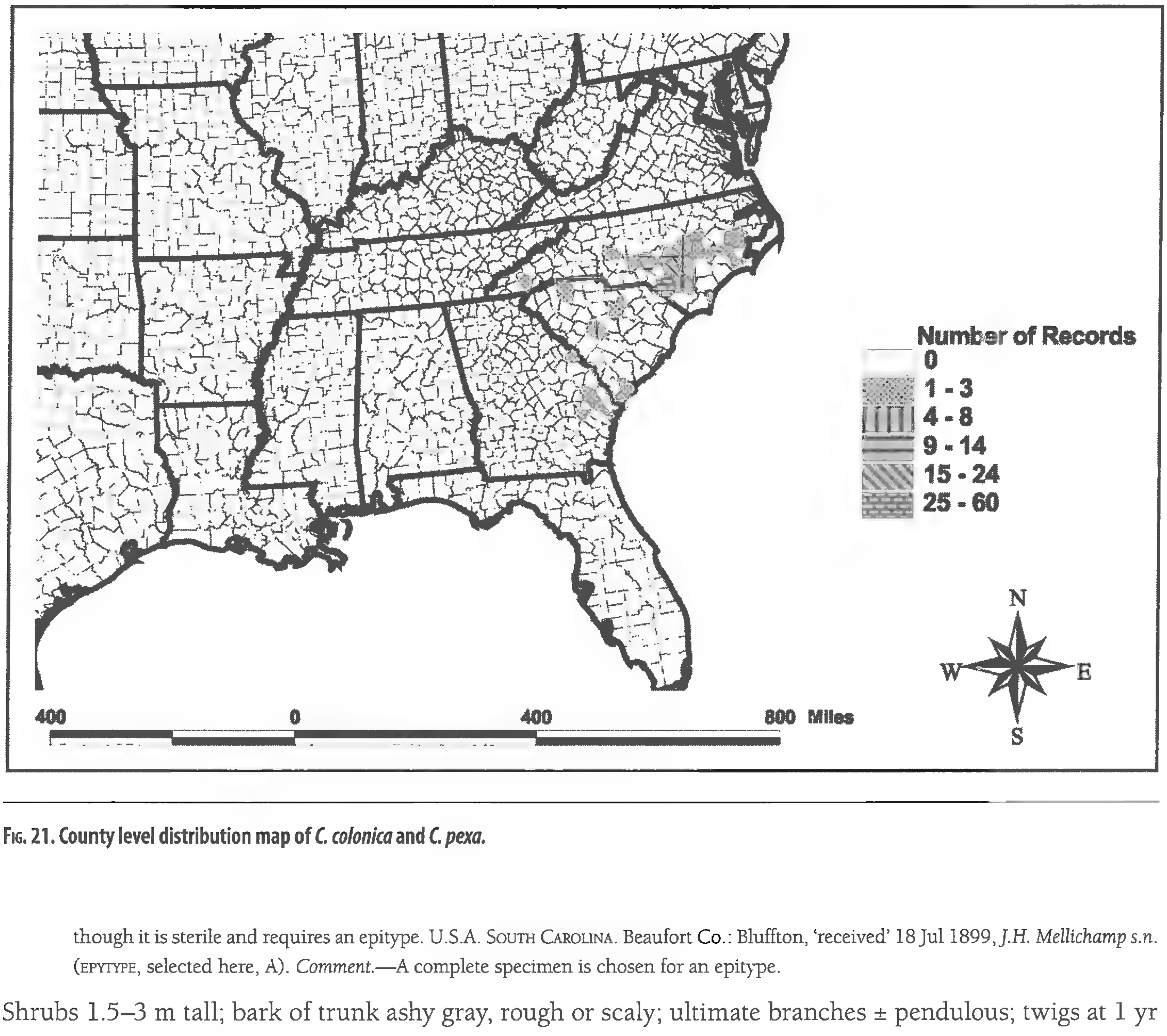

Fig. 21. County level distribution map of *C. colonica* and *C. pexa*.

though it is sterile and requires an epitype. U.S.A. South Carolina. Beaufort Co.: Bluffton, 'received' 18 Jul 1899, *J.H. Mellichamp s.n.* (EPYTYPE, selected here, A). *Comment.*—A complete specimen is chosen for an epitype.

Shrubs 1.5–3 m tall; bark of trunk ashy gray, rough or scaly; ultimate branches ± pendulous; twigs at 1 yr old ± flexuous, purple-brown or blackish, older dark gray; extending twigs densely white-canescent; usually very thorny, thorns 2–4.5 cm long, straight or slightly recurved, blackish or purple-brown at 1 yr old. Leaves deciduous; petioles short, ca. 15% length of blade, densely pubescent; blades white-hairy at anthesis, particularly on the veins below; 1.5–2.5(–3) cm long, obovate in general shape, sides gradually tapered into the winged upper part of the petiole; tip acute and ± cuspidate to ± obtuse, essentially entire to subentire, though distal margins somewhat denticulate; white-tomentose above and below when young, especially on the veins below, glabrescent adaxially; venation craspedodromous, 2–4(–5) lateral veins per side on all but small leaves; ± coriaceous. Inflorescences 2–4-flowered; branches tomentose, bearing deciduous, oblong-linear, membranous, gland-bordered bracteoles; flowering early to mid-April. Flowers 12–15 mm wide; hypanthium externally tomentose; calyx-lobes 4 mm long, narrow-triangular, abaxially ± tomentose, margins finely toothed, teeth glandular; petals ± circular, white; stamens 20, anthers cream or ivory; styles 3–5. Fruit typically 6–9 mm diam., pyriform or subglobose, green turning red or blushed red in mid-late August, pubescent; calyx-lobes spreading; nutlets 3–5, dorsally grooved, sides plane.

Distribution (Fig. 21).—This species occurs somewhat locally in the southeastern United States, especially the Carolinas, being particularly abundant in south-central North Carolina. It is found on sand hills, in dry sandy woodlands, sandy roadsides, etc.

Crataegus colonica is a rather distinct from most other species of this series on account of its thorniness combined with a rather distinctive leaf-shape reminiscent of forms of *C. crus-galli* together with its small, ±

pyriform fruit. However, whether the next entity, which has a similar distribution and thorniness, should be included, widening the phenetic width of *C. colonica*, is not yet clear.

13. Crataegus pexa Beadle, Biltmore Bot. Stud. 1:116. 1902. (**Fig. 20**). TYPE: U.S.A. NORTH CAROLINA. Rowan Co.: near Salisbury, 28 Apr 1897, Biltmore Herbarium 300b (LECTOTYPE, selected here: US 981163).

"Small shrub," on only specimen with indication of stature, differing from *C. colonica* as follows: branchlets very flexuous; extending twigs densely white-tomentose, 1-year old twigs dark gray; older gray; thorns generally numerous, at 2 years 3–5(–7) cm long, slightly to strongly recurved, purple-black at 1 year, older blackish, slender. Leaves deciduous; petioles 3–8 mm long, 10–20% length of blade, tomentose and somewhat glandular young; blades 1.5–3 cm long, obovate to obovate-rhombic in general outline, often narrowly so; apex acute to obtuse, not or obscurely lobed; margins strongly crenate-serrate for most of their length; venation craspedodromous, 2–3 veins per side; white-tomentose both sides young, indumentum thinner at maturity; somewhat coriaceous and dark at maturity. Inflorescences 1–3-flowered; branches tomentose, bearing deciduous, oblong-linear, membranous, gland-margined bracteoles. Flowers 12 mm diam.; hypanthium externally dense-tomentose; calyx-lobes ± linear, margins gland-toothed, tomentose abaxially; petals ± circular, white; stamens 20, anther colour not recorded; styles ca. 4. Fruit 8–10 mm diam., subglobose (a little taller than broad), ?orange at maturity, tomentose; calyx-lobes reflexed; nutlets ca. 4, dorsally grooved, sides plane.

Distribution (Fig. 21).—This entity is widely distributed in North Carolina and there are a few records from South Carolina and Georgia. It is found in dry woodlands, etc.

Crataegus pexa resembles *C. colonica* in its very thorny nature, most vegetative characteristics and general distribution. However, unlike the latter, its leaf margins are normally conspicuously crenate-serrate. Particularly thorny taxa are unusual in ser. *Lacrimatae* and as this species has such a similar distribution to the very thorny *C. colonica* more work on possible conspecificity is needed. Compared to *C. condigna*, plant stature is probably generally lower, the leaf blades are relatively broader, the thorns longer and always abundant and the twigs are particularly zig-zag. Also the leaf margination is different, see figures. Uncertain of the correct name at the time, *C. pexa* has been annotated as *C. "acantho-dentata."*

14. Crataegus teres Beadle, Biltmore Bot. Stud. 1:43. 1901. TYPE: U.S.A. ALABAMA. Montgomery Co.: Montgomery, 15 Apr 1900, *C.D. Beadle 2169* (LECTOTYPE, selected here: US; ISOTYPE: NY).

Comments.—There is a probable isotype at A with identical notes except lacking a collection number; the fruiting co-types at US and NY have blunter marginal teeth than the lectotype and uniformly blunt leaf-tips.

Shrubs or small trees, 3–6 m tall; with only slightly flexuous twigs; extending shoots subglabrous; 1-year old tawny to reddish-brown; 2-year old dark gray; 2 year old thorns 2–3 cm long, ± fine to fairly stout, ± straight, shiny blackish-gray. Leaves deciduous; petioles 0.3–0.7 cm long, somewhat pilose young, very glandular; blades 2–3.5 cm long, narrowly obovate in general shape, apex overall flat-triangular to rounded or ± truncate, often minutely cuspidate; ± evenly tapered proximally; lobeless; margins finely dentate, the teeth gland-tipped; venation craspedodromous, (2–)3–4 veins per side; sparsely hairy on the veins adaxially, glabrous abaxially; thin, shiny and dark green above at maturity, when slightly coriaceous; extension shoot leaves broad-elliptic to suborbiculate, larger, often slightly lobed, strong-toothed. Inflorescences 2–6-flowered; branches subglabrous, bearing deciduous, linear, membranous, gland-bordered bracteoles. Flowers ca.16 mm diam.; hypanthium glabrous; calyx-lobes 4–5 mm long, narrow-triangular, with glandular-serrate margins; petals ± circular, white; stamens 20, anthers pale yellow; styles 2–3. Fruit 8–10 mm diam., ±e llipsoid, red; calyx-lobes 7 mm long, spreading, thinly hirsute adaxially, narrow-triangular, gland-margined; nutlets 2–3.

Distribution.—Pine woods and sandy fields, south-central Alabama, scarce.

Crataegus teres and the following two species, *C. florens* and *C. attrita*, appear to form a natural group and may be difficult to distinguish. Characters that unite them are the ± lobeless leaves with ± sharply denticulate margins that are subcoriaceous and bright to deep green at maturity, subglabrous vegetative

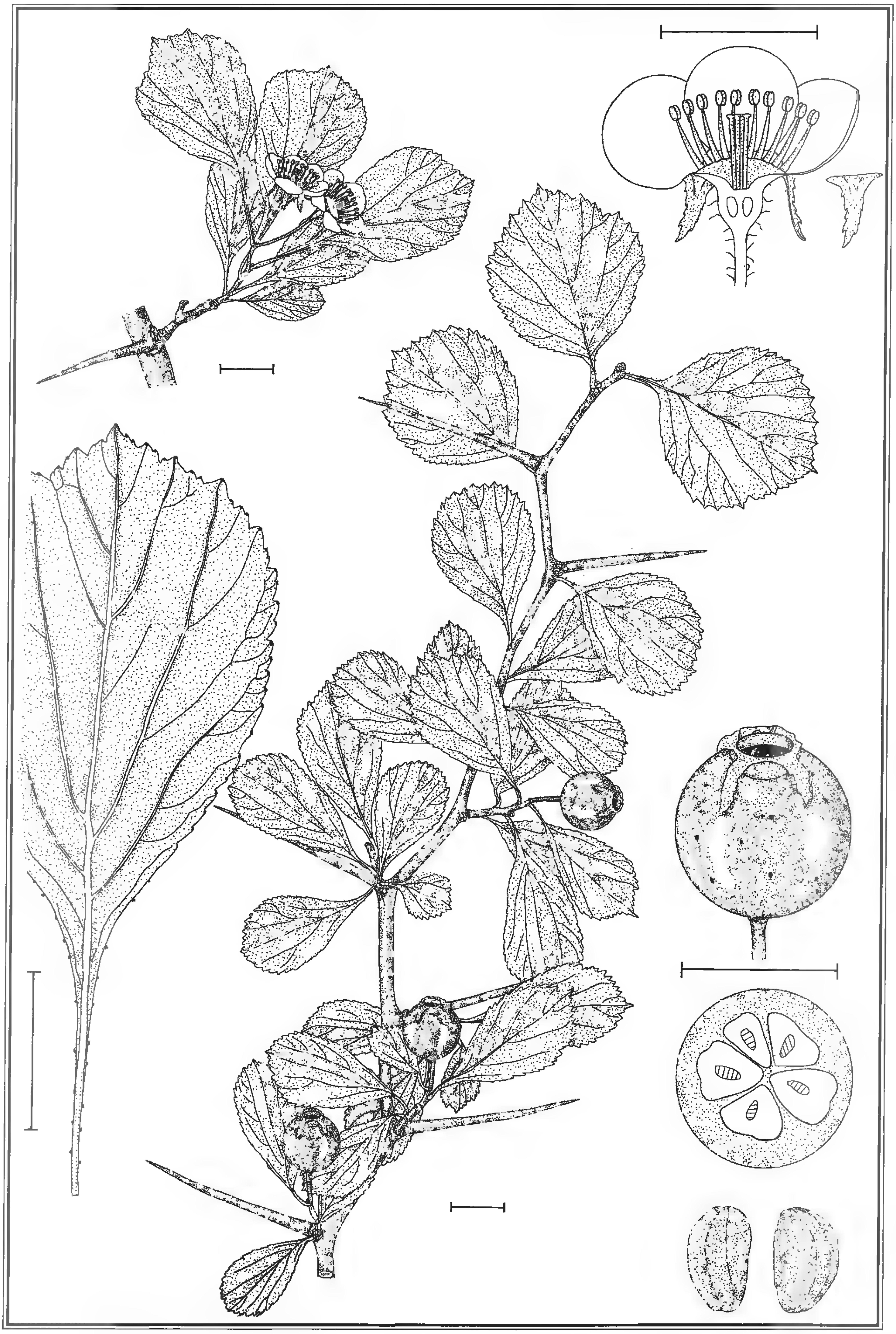

Fig. 22. Line drawing of *Crataegus florens* from *J.B. Phipps 7685* (UWO), flowering and *J.B. Phipps 6768* (UWO), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

parts, and inflorescence branches that lack the dense tomentum characteristic of many members of series *Lacrimatae* and which instead, range from subglabrous to pilose. *Crataegus teres* has perhaps the most individual characteristics of the three, manifesting less of a zig-zag twig, having the smoothest leaf tips, more venous leaves (usually 3–4 per side), subglabrous to pilose inflorescences and only 2–3 styles and nutlets, an ensemble of characters not unlike what might be found in ser. *Crus-galli*. It is the least common of the three.

15. Crataegus florens Beadle, Biltmore Bot. Stud. 1:94. 1902. (**Fig. 22**). TYPE: U.S.A. MISSISSIPPI. Lowndes Co.: Columbus, Apr 25 1901, *T.G. Harbison 4176, fragment* (LECTOTYPE, selected here: NY).

Comments.—Though a fragment there is enough lectotype material supporting the protologue to assure identification. As with other NY types of Beadle names based on fragments the collection is attributed to W.W. Eggleston but WWE's notes are invariably identical to those of the original and presumably, true, collector.

Shrubs or small trees, 3–6 m tall; with flexuous branchlets; extending shoots thinly to more densely spreading-pubescent; 1-year old tawny to reddish-brown; 2-year old dark gray; 2 year old thorns 2–4.5 cm long, ± fine to fairly stout, straight to slightly decurved, shiny blackish- gray. Leaves deciduous; petioles 0.5–1.5 cm long, somewhat pilose young, glandular; blades 2–4.5 cm long, narrowly obovate to obovate in general shape, apex often ± cuspidate, else obtuse to subacute at the tip, fairly rapidly tapered into the petiole; usually without trace of lobes, sometimes with 1–2 obscure lobes in the distal part; margins ± dentate, the teeth large at least at anthesis, gland-tipped; venation craspedodromous, 2–4(1–2 in type) veins per side; sparsely hairy on the veins above and below, elsewhere glabrous; shiny and dark green above at maturity, thin, but slightly coriaceous; extension shoot leaves broad-elliptic to ± orbicular, large, often slightly lobed, strong-toothed. Inflorescences 3–6-flowered; branches thinly spreading-pubescent, bearing deciduous, linear, membranous, gland-bordered bracteoles. Flowers 15–18(20–25, Beadle) mm diam.; hypanthium externally pubescent; calyx-lobes 4–5 mm long, narrow-triangular, with glandular-serrate margins; petals ± circular, white; stamens 20, anthers pale yellow; styles 3(–5, Beadle). Fruit 8–15 mm diam., ± globose, orange-red to red; calyx-lobes 7 mm long, spreading, thinly hirsute adaxially, narrow-triangular, gland-margined; nutlets 3(–5, Beadle).

Distribution (Fig. 23).—*Crataegus florens* occurs mainly from central Mississippi to the Carolinas and Florida and is quite common in central Alabama. However, I have seen one unambiguous specimen from West Feliciana Parish, Louisiana (this is still east of the Mississippi, however). This species is found in brushy thickets on sand-plains, often in more mesic habitats than other members of ser. *Lacrimatae.*

Crataegus florens is differentiated from *C. teres* by the characters given in the key and also discussed under the latter species. Here we expand on the protologue and type specimen to include all forms of smaller flower dimensions and with larger, more strongly dentate leaves, thus including those with 3–4 veins per side but in other respects still quite different from *C. teres*. With this broadened circumscription, *C. florens* is a fairly common species. Differences from *C. attrita* are discussed under that species.

Crataegus florens is somewhat early flowering as interpreted here, before most other sympatric *Lacrimatae*, and much earlier than the type. The flowers are also much smaller than the protologue dimensions and as the veins are fewer than in the type it may finally prove that typical *florens* is very rare and therefore much of the material here attributed may eventually have to be transferred to a broadened *C. attrita*. But at the moment these matters must be left in abeyance. *Crataegus florens* as interpreted here is a striking plant with zig-zag twigs and fine glossy deep green leaves, superficially resembling members of ser. *Crus-galli.*

15a. Crataegus attrita Beadle, Biltmore Bot. Stud. 1:98. 1902. TYPE: U.S.A. ALABAMA. Dale Co.: Ozark, 11 Apr 1901, *T.G. Harbison 4116* (LECTOTYPE, selected here: US).

Shrubs or small trees 2–5 m tall; trunk bark rough or rimose; branches "recurved" (? = drooping); one year old twigs dull gray; extending twigs glabrous, dark greenish–red; thorns ca. 2 cm long, ± straight, dark grayish-black at one year. Leaves deciduous; petioles 30% length of blade, slender, very short pubescent in the sulcus, with a few sessile marginal glands; blades 2–3.5 cm long, cuneiform in general shape, tapered to

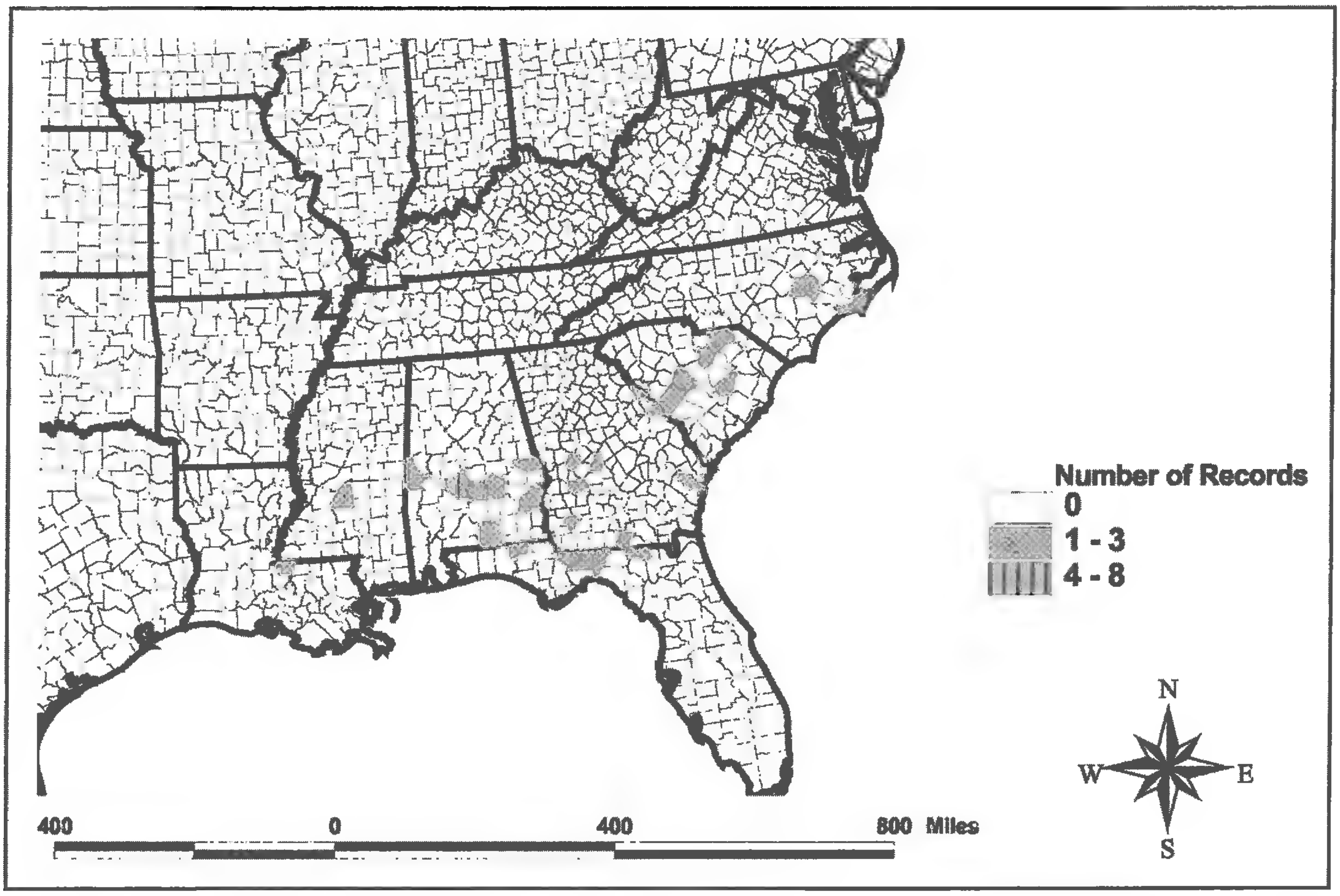

Fig. 23. County level distribution map of *Crataegus florens*.

the base, the apex rounded in general outline; margins dentate, the teeth gland-tipped, occasionally with a shallowly subterminal lobe on each side; venation semi-camptodromous with 1–3 lateral veins per side originating in the proximal part of the leaf and ending in the widest (distal) third of the blade; surfaces glabrous except for some tomentum along the proximal end of the midvein on both sides and tufts of hair in the main axils abaxially; thin. Inflorescences usually 2–3-flowered; branches glabrous or extremely sparsely pilose, bearing deciduous, membranous, linear, gland-margined bracteoles. Flowers 18–22 mm wide; hypanthium glabrous to very sparsely hairy; calyx-lobes 4–5 mm long, ± ligulate from a broad base, ± entire with some marginal glands, abaxially glabrous; stamens ca. 20, anthers cream; styles 3–5. Fruit 10–14 mm diam., subglobose, glabrous, at maturity yellow splashed red; calyx-lobes neither seen (JBP) nor recorded (Beadle); nutlets 3–5.

Distribution.—This is a rare species known only from southeastern Mississippi (Lowndes Co.), southeastern Alabama (Dale and Greene Cos.) and adjacent Florida (Washington Co.). Another specimen only differing in its densely pubescent inflorescence is known from South Carolina's 'Haw Ridge.'

Crataegus attrita is essentially similar to *C. florens* and *C. teres* and is generally intermediate between the two. Its dense tufts of hair in the abaxial vein axils are reminiscent of *C. aestivalis.*

15b. Crataegus pulla Beadle, Biltmore Bot. Stud. 1:96. 1901. TYPE: U.S.A. MISSISSIPPI. Lowndes Co.: Columbus, 25 Apr 1901, *T.G. Harbison 4181* (LECTOTYPE, selected here: NY).
Comment.—there is a good fruiting syntype at US.

Crataegus pulla is a little known species apart from excellent type material and the good protologue. It is a shrub 4–5 m high, with pendulous branches, ± obovate leaves which are at first ± tomentose, and then variably somewhat glabrescent, notable for its coarsely and rather irregularly toothed leaves often with a single, small, somewhat obscure lobe on each side. The flowers are borne on 2–5-flowered inflorescences

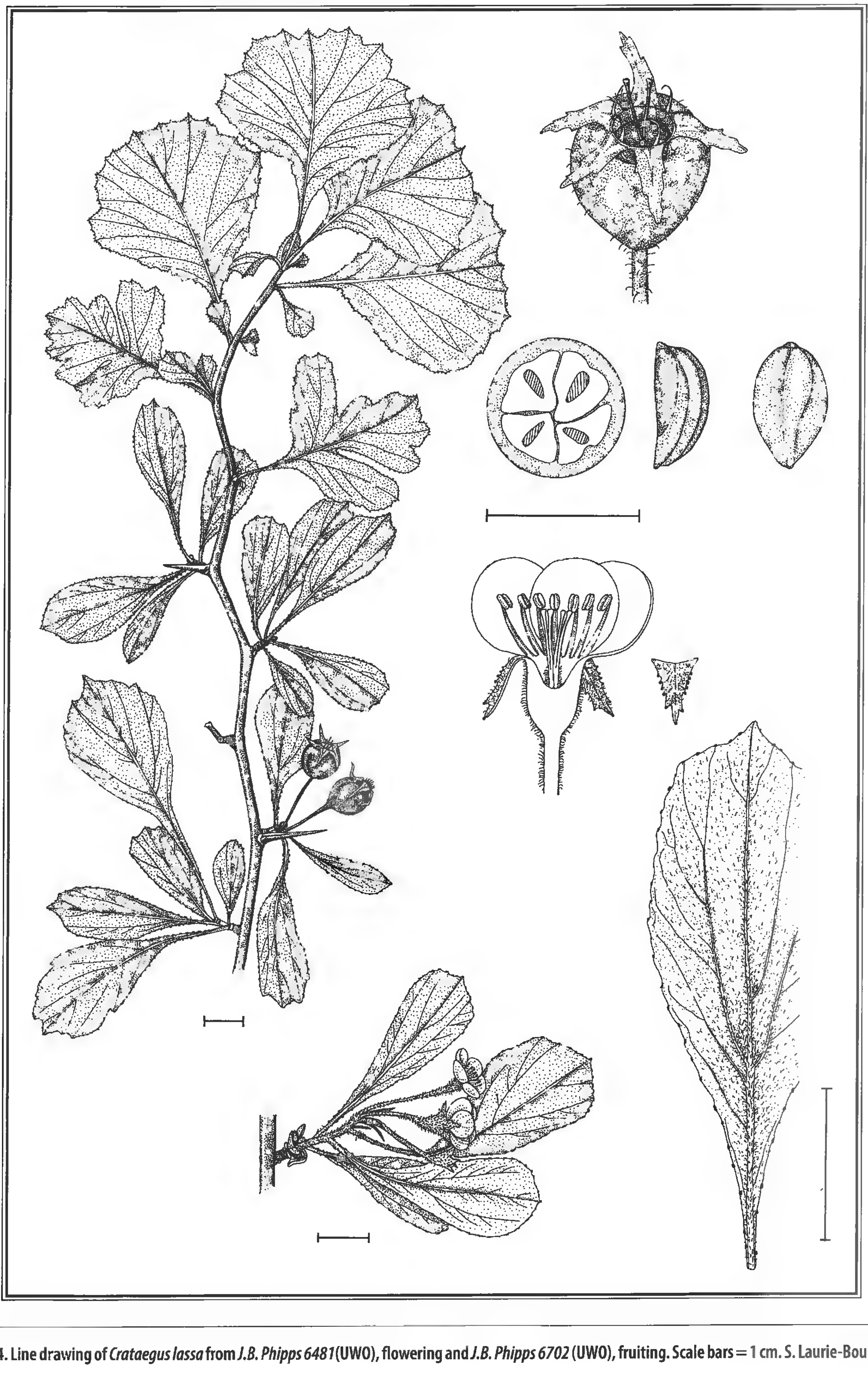

Fig. 24. Line drawing of *Crataegus lassa* from *J.B. Phipps 6481*(UWO), flowering and *J.B. Phipps 6702* (UWO), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

and are 14–17 mm wide. The fruits are subglobose to ellipsoid, 9–12 mm wide, yellowish or orange–yellow flushed red.

Distribution.—*Crataegus pulla* was described from sandy flats along the Tombigbee River, Mississippi.

16. Crataegus lassa Beadle, Biltmore Bot. Stud. 1:29. 1901. (**Fig. 24**). Type: U.S.A. Alabama. Dale Co.: Selma, 5 Aug 1899, *C.D. Beadle 871* (lectotype, selected here: NY).

Crataegus illudens Beadle, Biltmore Bot. Stud. 1:111. 1902. Type: U.S.A. Florida. Marion Co.: Citra, 28 Mar 1901, *C.D. Beadle 4055, fragment* (lectotype, selected here: NY).

Crataegus panda Beadle, Biltmore Bot. Stud. 1:89. 1902. Type: U.S.A. Florida. Leon Co.: Tallahassee, Sep 1901, *T.G. Harbison 4051* (lectotype, selected here: A; isotype: NY).

Shrub or small tree 2–5 m tall; bark of trunk ashy gray, rough or scaly; ultimate branches ± pendulous; twigs at 1 yr old ± flexuous, purple-brown or blackish, older dark gray; extending twigs densely white-canescent; often thornless, or with rare thorns 3–4.5 cm long, straight or slightly recurved, blackish or purple-brown at 1 yr old. Leaves deciduous; petioles 0.5–1.5 cm long, usually 25–33% length of blade, densely pubescent, gland-margined; blades 2–4 cm long at maturity, obovate-cuneate to narrow obovate in general shape, the tip often strikingly cuspidate, essentially entire; sides gradually tapered into the winged upper part of the petiole; margins glandular, denticulate to subentire; into the winged upper part of the petiole; margins glandular, denticulate to subentire; venation craspedodromous, 2–4(–5) lateral veins per side on all but small leaves; ± white-pubescent above and below when young, especially on the veins below, glabrescent; ± coriaceous. Inflorescences 3–5-flowered; branches tomentose, bearing deciduous, linear, membranous, gland-bordered bracteoles; flowering early to mid-April. Flowers 15–20 mm wide; hypanthium externally tomentose; calyx-lobes 6–8 mm long, narrow-triangular, abaxially ± tomentose, especially at base and in centre, margins finely toothed, teeth glandular; petals ± circular, white; stamens 20, anthers cream or ivory; styles 3–5. Fruit typically (8–)10–12 mm diam., subglobose, yellow blushed red to orange-red, pubescent; calyx-lobes spreading-recurved or lost; nutlets 3–5, dorsally grooved, sides plane.

Distribution (Fig. 25).—*Crataegus lassa* occurs in the southeastern United States from central Alabama to South Carolina and northern Florida and is particularly abundant around its type locality of Selma. It inhabits sand plains, dry scrubby places, thin woodland etc.

Crataegus lassa is a handsome plant with its normally large foliage and big, floppy leaves. The type material has rather shorter leaves than most specimens seen commonly near to Selma today and is notable for having a few small terminal lobes. *Crataegus illudens* is barely different but has somewhat longer leaves and leaf tips more often quite entire. *Crataegus panda* is a form with a slightly shorter and relatively broader leaf, minutely crenate on the margins. There are also a few intermediates with *C. integra*.

17. Crataegus lanata Beadle, Biltmore Bot. Stud. 1:86. 1902. (**Fig. 26**). Type: U.S.A. Georgia. Gwennett Co.: near banks of Yellow R. below McGuire's Landing, 21 Jun 1899, *C.D. Beadle 587* (lectotype, selected here: US).

? = *Crataegus amica* Beadle, Biltmore Bot. Stud. 1:97. 1902. Type: U.S.A. Florida. Marion Co.: Ocala, 20 Aug 1901, *C.D. Beadle 4004*^{2} (lectotype, selected here: NY). U.S.A. Florida. Marion Co.: Ocala, 21 Mar 1901, *C.D. Beadle 4004* (lectotype, selected here: US).

Crataegus ? inops Beadle, Biltmore Bot. Stud. 1:96. 1902. Type: U.S.A. Alabama. Dale Co.: Ozark, 1 Apr 1901, *T.G. Harbison 4113* (lectotype, selected here: US).

Shrubs to 4 or 6 m, broad-spreading when mature, branchlets often pendant; expanding twigs densely appressed white-pubescent; 1-year old brown to purple-brown, glabrous; thorns 1–4 cm long, ± straight, none to plentiful, slender, purple-brown. Leaves deciduous; petioles 3–6(–10) mm long, pubescent when young, strongly glandular; blades 3–5 cm long, narrowly to broadly obtrullate in general shape, or sometimes more obovate; tip acute to subacute, the base usually gradually tapered to the petiole; with 1–2(–3) short, but well-defined lobes per side across the terminal end; margins subentire to obscurely crenate-serrate, glandular; venation craspedromous with 2–3 strong lateral veins exiting above the broadest part of the leaf; pubescent above and below when young and at maturity. Inflorescences 1–4-flowered; branches densely white-canescent, bearing deciduous, linear, membranous, gland-margined bracteoles. Flowers about 17–20

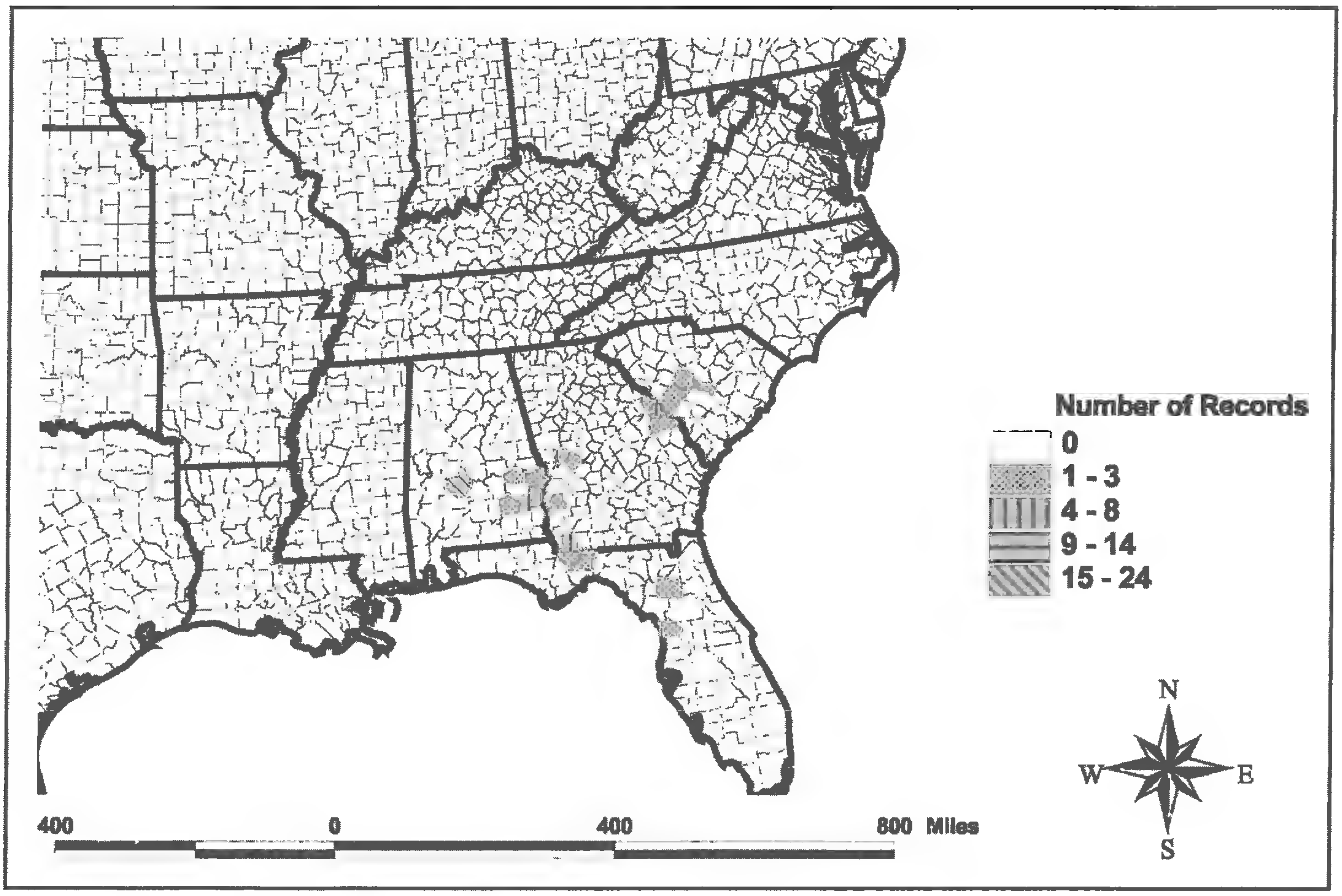

FIG. 25. County level distribution map of *Crataegus lassa*.

mm diam.; hypanthium externally densely canescent; calyx-lobes 5 mm long, narrow triangular, abaxially pubescent, margins gland-toothed; petals ± circular, white; stamens 20, anthers ivory; styles 4–5. Fruit up to 9 mm broad, subglobose to somewhat pyriform, generally orange or ruddy to crimson, somewhat pubescent; calyx-lobes reflexed; nutlets 4–5, dorsally sulcate, laterally smooth.

Distribution (Fig. 27).—This species occurs in the southeastern USA from Alabama to the Carolinas and northern Florida and is generally common. However, there is one record from Chesterfield Co., Virginia. It is found in pine barrens and open scrubby places, most commonly on sand.

Crataegus lanata is one of the most abundant taxa in series *Lacrimatae* and is noted for its very large (for this series), usually floppy, shallowly-lobed, kite-shaped leaves, somewhat white pubescent at all times. The leaves are typically clearly but shortly lobed (see illustration) and this is the common taxon that has been annotated *C. inops*. The fruit of *C. lanata* ripens to an attractive copper to red. Though the leaves are typically of quite a different shape from the *illudens* form of *C. lassa* (also illustrated), some intermediates with *C. lassa, sens. str.*, do exist. *Crataegus lanata* also intergrades with a long-leaved *lassa* type with a few very short subterminal lobes and these intermediates have mostly been annotated *C. ?inops*.Other variants with broader, more obovate leaves have been annotated as "cf. *inops*" and these may be the same as *C. amica*. These intermediates have as a rule been annotated to the taxon with which they were most similar

18. Crataegus furtiva Beadle, Biltmore Bot. Stud. 1:81. 1902. (**Fig. 28**). TYPE: U.S.A. GEORGIA. Dougherty Co.: Albany, 24 Aug 1901, *C.D. Beadle 4865* (LECTOTYPE, selected here: NY).

Shrubs, 3–4 m tall or small trees to 6 m; extending twigs densely appressed white-pubescent, 1-year old twigs purple-brown; older deep gray; usually unarmed but sometimes with thorns, about 2–3 cm long, straight, these same color as twigs of the same age. Leaves deciduous; petioles 3–6 mm long (unwinged part), widen-

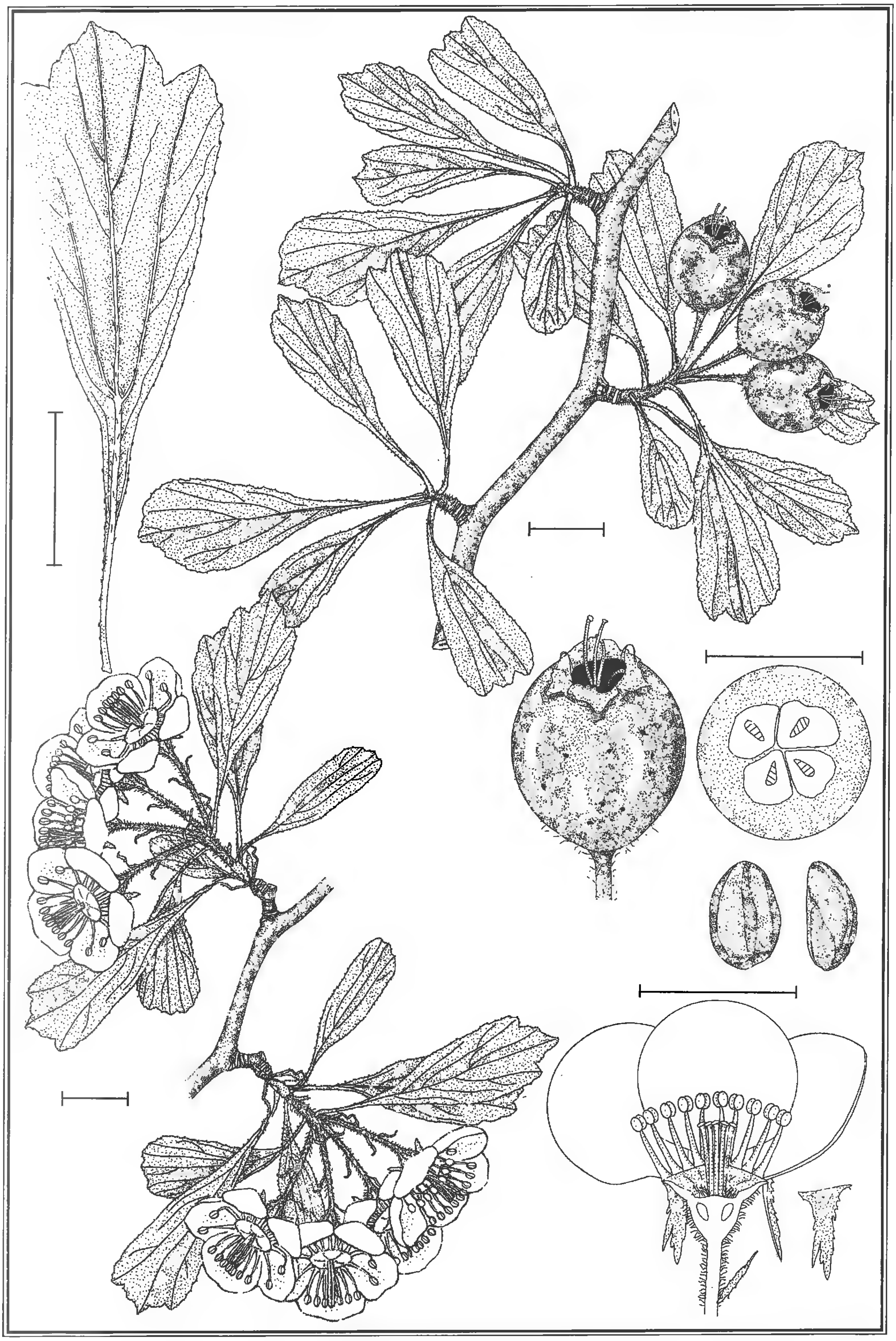

Fig. 26. Line drawing of *Crataegus lanata* from *J.B. Phipps 6482* and *7691* (both UWO), flowering and *J.B. Phipps 6722* (UWO), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

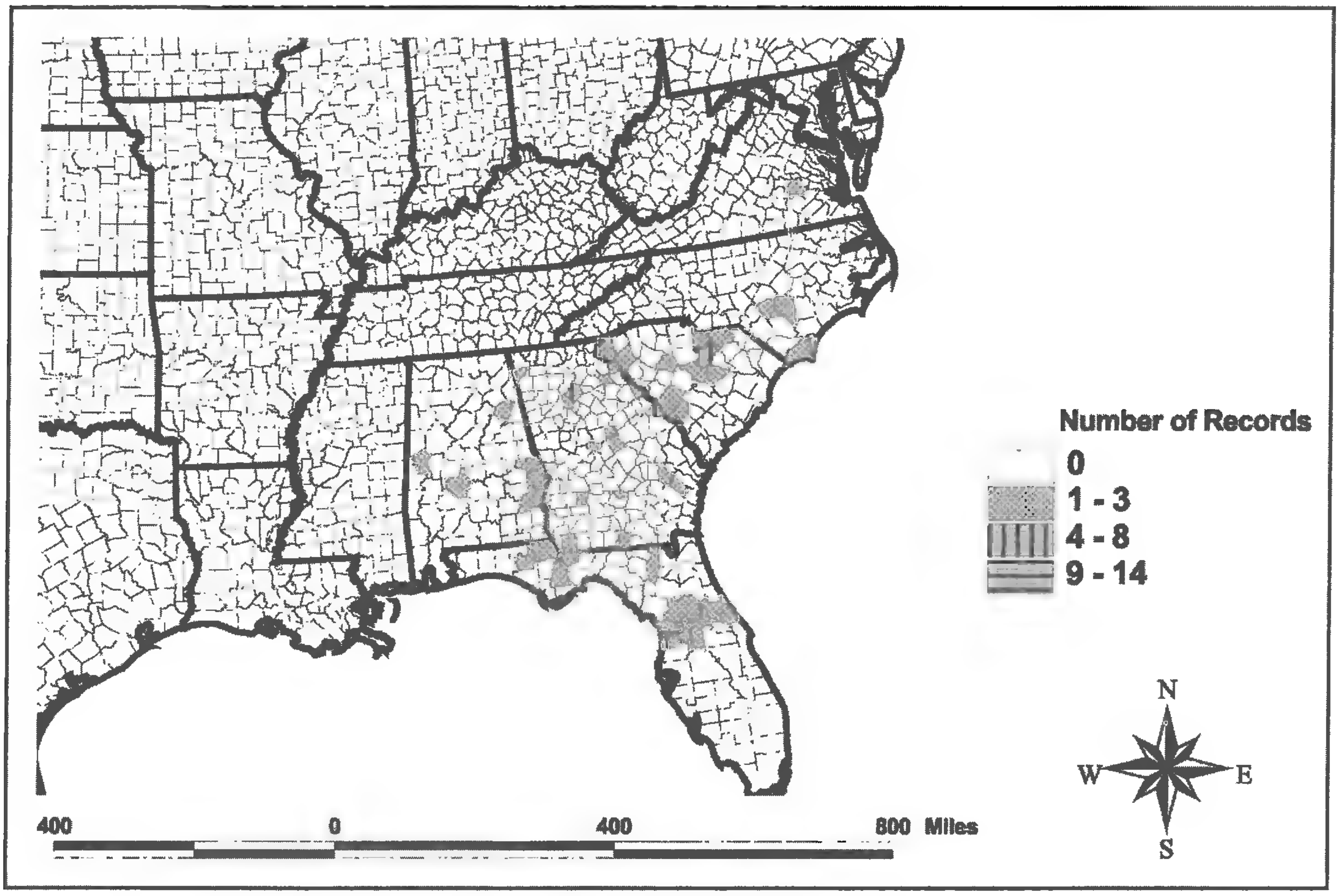

Fig. 27. County level distribution map of *Crataegus lanata*.

ing above into a broad wing, pubescent, glandular; blades 1.5–2.5 cm long, broadly obtrullate or obdeltate to obtrullate in general shape; base tapered very rapidly into the winged upper part of the petiole; often shallowly and bluntly 3-lobed across the top, occasionally only sharply cuspidate, alternatively with more acute tip in the narrower-leaved forms; margins finely and obscurely crenate, the teeth gland-tipped; venation craspedodromous with 2–3 lateral veins per side, these diverging at a narrow angle from the mid-vein; surfaces densely tomentose when young, variably glabrescent later. Inflorescences 2–4-flowered; branches densely tomentose-canescent, bearing deciduous, ± linear, membranous, gland-margined bracteoles; anthesis mid-April in central Georgia. Flowers 14–16 mm diam.; hypanthium externally densely white appressed-pubescent; calyx-lobes ca. 5 mm long, narrowly triangular, abaxially appressed white-pubescent, margins with gland-tipped teeth; petals ± circular, white; stamens 20, anthers cream; styles 3. Fruit 8–15 mm diam., broad-ellipsoid to ± orbicular, glabrous to thinly pilose, orange to red; calyx-lobes reflexed; nutlets ca. 3, dorsally grooved, laterally smooth.

Distribution (Fig. 29).—This species is concentrated in Georgia and South Carolina with a few additional records from North Carolina, Alabama and Florida. It is found in open brushy places, most usually on sandy soils, often among thin pine.

Crataegus furtiva, as it is usually seen, has among the smallest leaves of the thick-twigged group and is one of the most densely hairy of all series *Lacrimatae* when young. Its usually broad, obtrullate leaves (as illustrated) are quite distinctive. It represents what was at first held to be *C. lanata*. However, the narrower leaved form, which is also quite common, is the type form. In spite of some variability in leaf shape and fruit size, shape and residual indumentum, this species is generally easily recognized.

19. Crataegus meridiana Beadle, Biltmore Bot. Stud. 1:115. 1902. Type: U.S.A. Alabama. Dale Co.: Ozark, 11 Apr 1901, *T.G. Harbison 4114* (lectotype, selected here: US; isotype: fragment at NY).

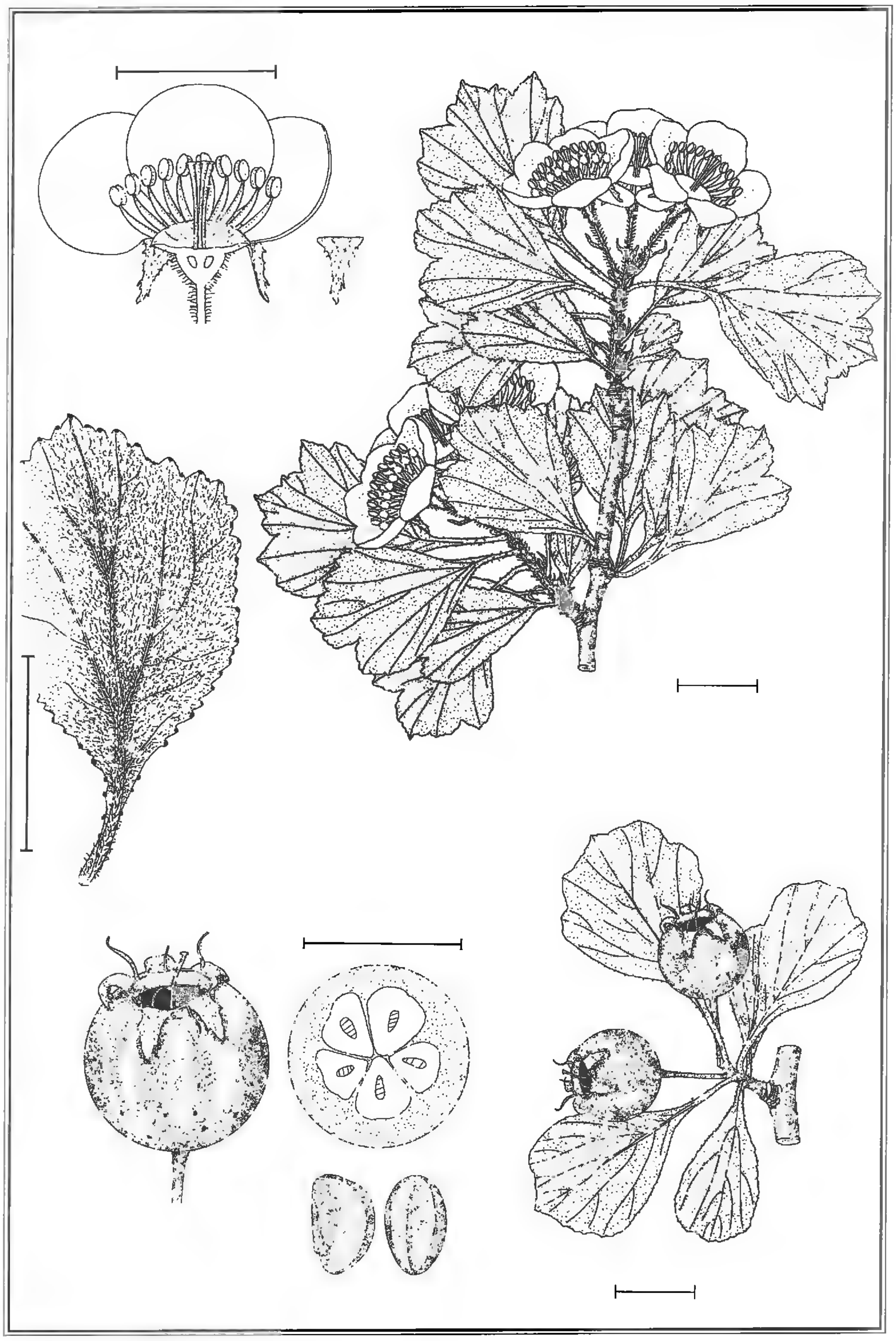

Fig. 28. Line drawing of *Crataegus furtiva* from *J.B. Phipps 6555* and *7688* (both UWO), flowering and *J.B. Phipps 6674* (UWO), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

Shrubs or small trees 3–7 m tall; branchlets zig-zag at nodes; elongating twigs appressed-pubescent, 1-year old gray-brown to blackish gray; unarmed or with occasional thorns 2–3.5 cm long, ± straight, slender, purple-brown at 1 year, becoming gray. Leaves deciduous; petioles 3–9 mm long, persistently pubescent, glandular; blades 2–4 cm long at maturity, 1/3 smaller at anthesis, narrowly to broadly cuneate to obtrullate in general shape, shallowly and quite sharply 1–3 lobed subterminally at anthesis, a bit more bluntly at maturity; ends rounded to subacute in general shape; margins crenate-serrate, glandular; venation craspedodromous, with 2–3 lateral veins per side; pubescent on both surfaces, dense-tomentose abaxially on veins, often becoming floppy. Inflorescences 2–4-flowered; branches appressed-canescent, bearing deciduous, linear, membranous, gland-margined bracteoles. Flowers 18–20 mm diam.; hypanthium externally densely

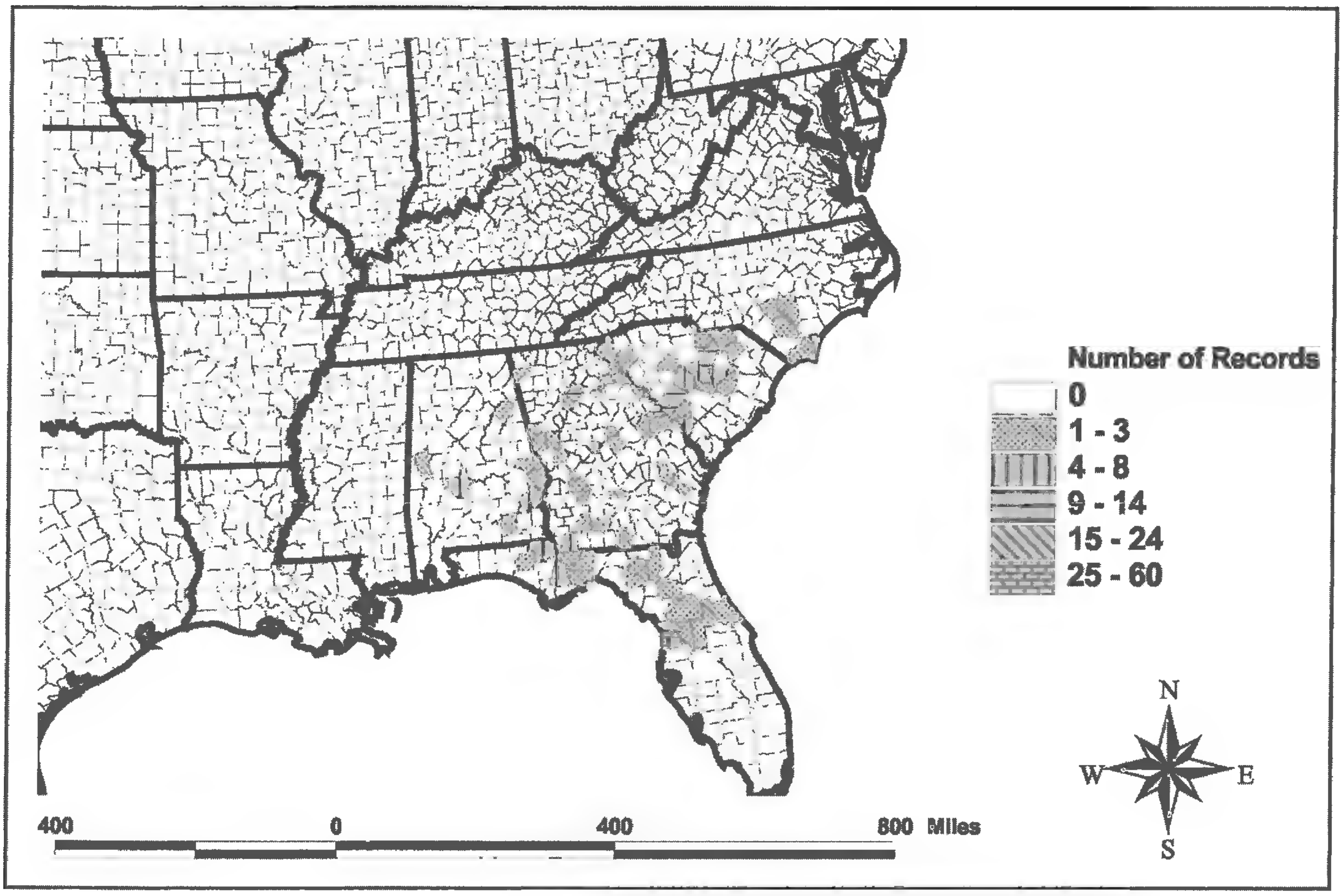

Fig. 29. County level distribution map of *Crataegus furtiva*.

canescent; calyx-lobes 4–6 mm long, narrow-triangular, abaxially somewhat pubescent, margins gland-toothed; petals ± circular, white; stamens 20, anthers ivory; styles 2–4(–5,Beadle). Fruit 9–12 mm diam., subglobose, somewhat pubescent, orange-yellow to ruddy; calyx-lobes on a distinct collar, reflexed; nutlets 2–4(–5, Beadle), dorsally sulcate, sides plane.

Distribution.—This species occurs in the southeastern United States where it is known from Georgia, South Carolina and north central Florida. There are also a few records from Alabama. It is found in open brushy places and woodland.

Crataegus meridiana is a rather poorly understood complex of long-petiolate, terminally lobed forms but more shortly or obscurely so than in *C. senta*. The general form of the leaf is not unlike that of that of *C. quaesita* although extension shoot leaves are more likely to be ± isodiametric in *C. meridiana. Crataegus meridiana* is quite thorny and the thorns tend to be slender. The somewhat similar *C. lassa* has rather larger leaves with blunt or obscure lobes and shares floppy leaves with *C. meridiana*. Some more delicate specimens of this species might key out via subser. *Tenues* to *C. floridana*. See also comments under *C. quaesita*.

20. Crataegus lancei J.B Phipps, sp. nov. (**Fig. 30**). Type: U.S.A. North Carolina. Buncombe Co.: NW of Weaverville, New Stock Road at Alpine Meadows development, 28 Sep 2008, *R. Lance 3408* (holotype: UWO; isotypes: A, GAM, UNC, US).

Comment.—*Crataegus lancei* may prove to be the same as *C. yadkinensis* Ashe (J. Elisha Mitchell Sci. Soc. 17:17. 1900) but Ashe's protologue is insufficient for certainty and no authentic material of that species has been discovered.

Frutices vel arbores parvae, 5–8 m alti; ramuli extensi dense-pubescentes vel tomentosi; annotini purpureo-brunnei vel atri, veteriores atrocinerei; spinae nullae vel numerosae, 3–4 cm longae, purpureo-brunneae vel aliquantum atrae in anno secundo. Folia decidua; petioli 3–7 cm longi, pubescentes, glandulosi; laminae 2–3 cm longae, anguste-obovatae vel obtrullatae vel interdum oblanceolatae in forma generali, ± contractae in basi, lateriores prope apicem; apices acuti vel obtusi; pars distalis cum 1–2(–3) lobis brevibus per latus; margines glandulo-crenato-serratae; venatio craspedodroma, 1–3 venis per latus, finem habens trans latissimam folii; superficies primo canescentes vel floccosae solum prope mediam venam, subglabrescentes in maturitate, praeter caespites pilorom abaxialiter in principalibus axillis. Inflorescentiae 3–7 floratae; rami pubescentes vel dense – pubescentes, ferentes deciduas, lineares, membranaceas, glandulo-marginatas bracteolas. Flores 10–12 mm diam.; hypanthium externe dense-pubescente, lobi calycis 3–4 mm longi, triangulares, ± pubescens abaxialiter, marginibus glandulo-serratis; petala ± circularia, alba; stamina 20, antheris cremeis; styli 3–4. Fructus 10 mm lati, ± orbiculares, saepe cuprei vel atrorubri; lobi calycis patento-reflexi; pyrenae 3–4, dorsaliter sulcatae, lateribus planis.

Shrubs or small trees 5–8 m tall; elongating twigs dense-pubescent to tomentose; 1-year old purple-brown to blackish, older dark gray; thorns lacking to numerous, 3–4 cm long, purple-brown to blackish in second year. Leaves deciduous; petioles 3–7 mm long, pubescent, glandular; blades 2–3 cm long, narrowly obovate to obtrullate or occasionally oblanceolate in general shape, ± contracted at the base, broadest near the apex; apex pointed to obtuse; end shortly 1–2(–3) lobed per side; margins glandular, crenato-serrate; venation craspedodromous, 1–3 veins per side, terminating beyond the widest part of the leaf; surfaces canescent to wooly hairy only near the midvein at first, tending to subglabrate at maturity except for tufts of hair in the main axils abaxially. Inflorescences 3–7-flowered; branches pubescent to densely pubescent, bearing deciduous, linear, membranous, gland-margined bracteoles. Flowers 10–12 mm diam.; hypanthium externally densely pubescent; calyx-lobes 3–4 mm long, triangular, ± pubescent abaxially, margins gland-toothed; petals ± circular, white; stamens 20, anthers cream; styles 3–4. Fruit 10 mm long, ± orbicular, often copper to deep red, ± pubescent; calyx-lobes patento-reflexed; nutlets 3–4, dorsally sulcate; sides plane.

Etymology.—I am pleased to honor Ron Lance, collector of the type, in the name of this species. Ron is one of the very few serious modern collectors of *Crataegus* in the southeastern United States.

Distribution.—This is a fairly common member of the thick-twigged group found from Alabama to both Carolinas as well as northern Florida and occurs in open scrub and woodland.

This is one of the narrow-leaved members of the thick-twigged group and when the narrower type of leaf, which is broadest about the middle, is plentiful it makes one of the most distinctive species in ser. *Lacrimatae*. However, leaf shape varies towards ± elliptic-oblong, unlobed, crenate-margined on the one hand to narrow-obovate (rarely narrow-ellipt-rhombic) with single well-defined but short, subterminal, tooth-like lobes each side on the other. Leaves on extension shoots only are likely to resemble those of *C. senta* when they are narrowly obtrullate and sharply lobed. Other striking features are inflorescences more floriferous than usual for the series and often dark orange to deep red, cherry-like fruit. *Crataegus lancei* may prove to be the same as *C. yadkinensis* but Ashe's protologue is insufficient for certainty and no authentic material of that species has been discovered. Annotations are mainly under *C. ?cullasagensis*, an error deriving from its type locality and Ashe's rather obscure leaf description, the error being corrected when the type of that species was discovered to belong to ser. *Pulcherrimae* or perhaps *Intricatae*.

21. Crataegus senta Beadle, Bot. Gaz. 30:341. 1900. (**Fig. 30**). Type: U.S.A. North Carolina. Buncombe Co.: Biltmore, abandoned fields, 11 May 1899, Biltmore Herb. C-18 (lectotype, selected here: US; isotype: A).

Shrubs or small trees to 6 m tall; 1-year old wood purplish-brown under an exfoliating wax, older twigs deep dull gray; thorns absent or numerous, if present 1.5–5 cm long, straight to slightly recurved, purplish-brown. Leaves deciduous; petioles 0.5–1 cm long, 30%–40% length of blade, roughly pubescent, black-glandular; blades ca. 3 cm long, oblong-spatulate to cuneate in general shape; base narrow cuneate, apex acute, generally cuspidate; sharply lobed with 1–2 acute lobes per side in the distal portion; margins strongly crenate-serrate almost to base, very black-glandular at maturity; venation craspedodromous with (2–)3–4(–5) lateral veins per side; dull green and sparsely hairy above at first, paler below and pubescent along the main veins and in the axils. Leaves on extension shoots larger, relatively broader and more deeply lobed. Inflorescences 3–7-flowered; branches dense short-canescent, bearing deciduous, linear, membranous, gland-margined bracteoles; anthesis early May near Asheville, North Carolina. Flowers 15–20 mm diam.; hypanthium externally tomentose; calyx-lobes narrow triangular, abaxially ± pubescent, margins glandular-serrate; petals ± circular, white; stamens 20, anther color not recorded; styles 3–5. Infructescences with 1–3 fruits; fruit 1 cm diam., subglobose, deep red, punctate, surface mostly glabrous; calyx-lobes patent to reflexed, narrow triangular, margins ± entire; nutlets 3–5, dorsally grooved, sides smooth.

Distribution (Fig. 31).—*Crataegus senta* has a very similar distribution to *C. lancei* and is a quite widespread species known to me from western North Carolina, South Carolina (where it is most common), northern

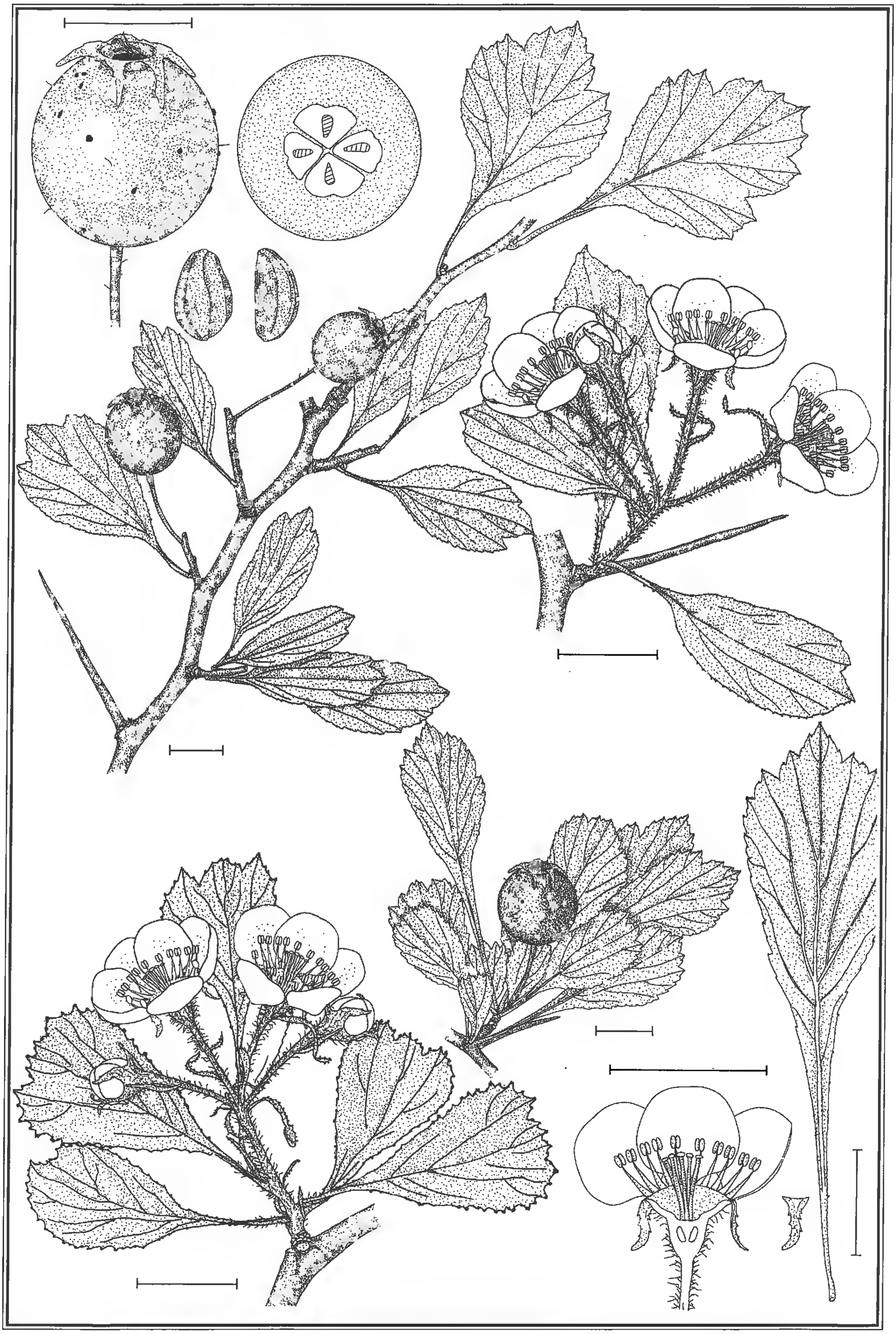

Fig. 30. Line drawings of: *C. lancei* (top) from *R. Lance s.n.*, 3 May 1999 (UWO), flowering and *R. Lance 2197 & 98-51* (UWO), fruiting; and *C. senta* (bottom) from *J.B. Phipps 6486 & 6554* (UWO), flowering and *R.K. Godfrey 82692* (UWO), fruiting. Scale bars = 1 cm. S. Laurie-Bourque del.

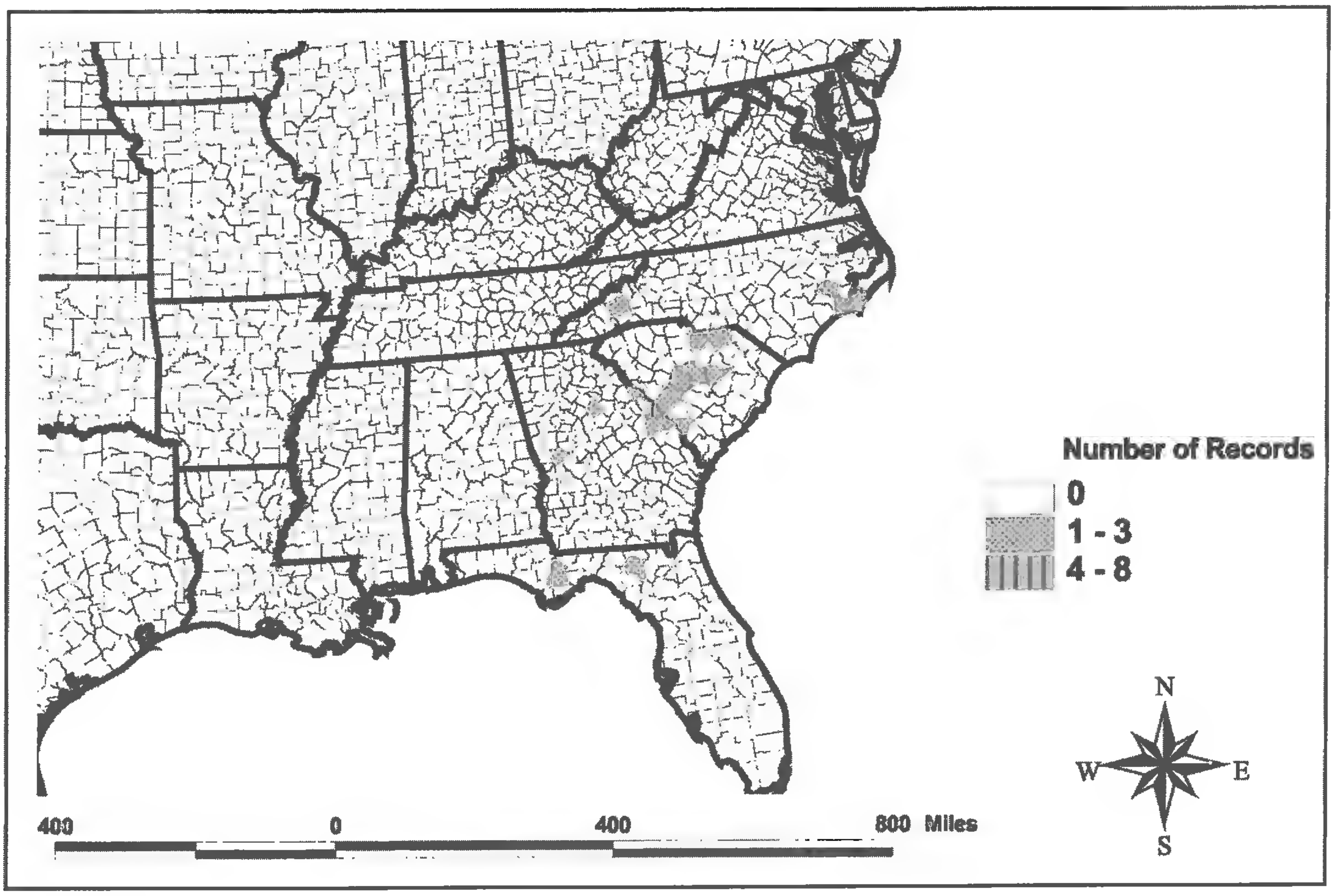

Fig. 31. County level distribution map of *C. senta*.

Florida and Georgia. However, there is also a disjunct record from West Feliciana Parish, Louisiana (not mapped). It inhabits dry pine woods, open scrub and sand plains like other members of the series.

This taxon most resembles *C. dispar* but its leaves have a narrower form and are not so lanate. Smaller leaves of *C. senta* have fewer veins (only 1–2 per side). *Crataegus senta* is very handsome in fruit.

22. Crataegus dispar Beadle, Biltmore Bot. Stud. 1:28. 1901. **(Fig. 32)**. Type: U.S.A. South Carolina: Aiken Co.: Aiken, 27 Jul 1900, *C.D. Beadle 2800* (lectotype, selected here: US).

Shrubs or small trees to 5 m; thorns none or several, 3–4 cm long, straight, purple-brown at 2-year old; extending shoots densely appressed-canescent; at 2–3 years, dark gray or gray-brown. Leaves deciduous; petioles 5–15 mm long, densely appressed- pubescent when young, glandular; blades 2.3–3.5 cm long, ± obovate-spatulate in general outline, acuminate at the tip and at the base gradually tapered to the petiole; generally with about two very acute subterminal lobes per side, the sinuses with LII 15–20%; margins strikingly toothed, the teeth gland-tipped; venation craspedodromous, 2–3 veins/side; ± glabrate above and below except near the veins. Inflorescences 2–4-flowered; branches densely appressed-pubescent, bearing deciduous, linear, membranous, gland-margined bracteoles. Flowers ca. 13–16 mm diam.; hypanthium densely pubescent; calyx-lobes 3 mm long, narrow, pubescent abaxially, margins gland-toothed; petals ± circular, white; stamens 20, anthers ivory; styles 4–5. Fruit 8–12 mm diam., orbicular, nearly glabrous to slightly pubescent, bright orange-red or reddish; calyx-lobes reflexed; nutlets 4–5, dorsally ridged, laterally smooth.

Distribution (Fig. 33).—This is a somewhat scarce but distinct plant of the southeastern United States that is concentrated in South Carolina but has scattered records from Georgia, Florida and Alabama. In South Carolina I have seen it growing in extremely dry conditions.

Crataegus dispar is one of the most easily recognized members of this series, even identifiable in speci-

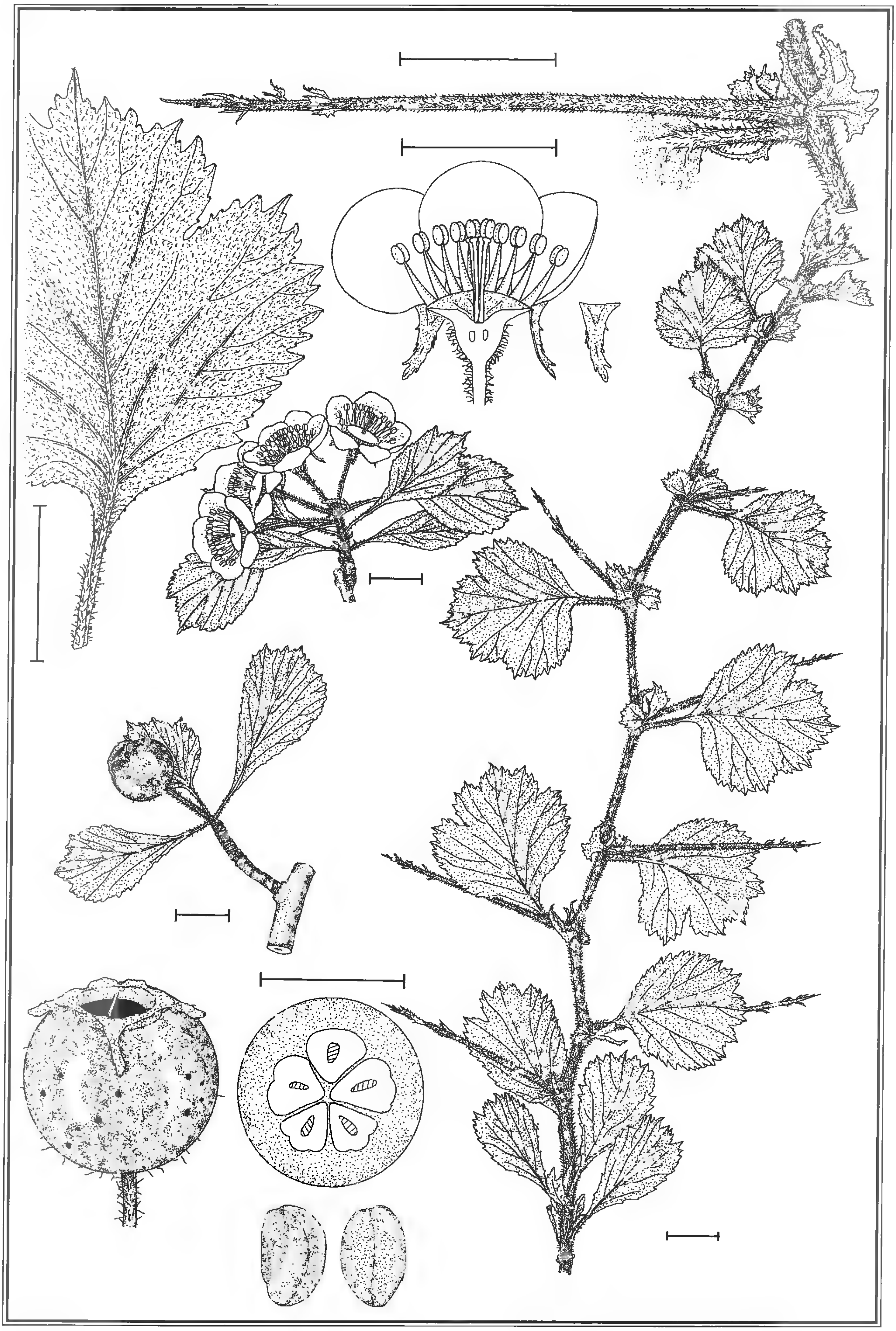

Fig. 32. Line drawing of *Crataegus dispar* from *J.B. Phipps 6505* plus photo of same (UWO), flowering, *J.B. Phipps 6685* (UWO), fruiting and *J.B. Phipps 6501* (UWO), sterile. Scale bars = 1 cm. S. Laurie-Bourque del.

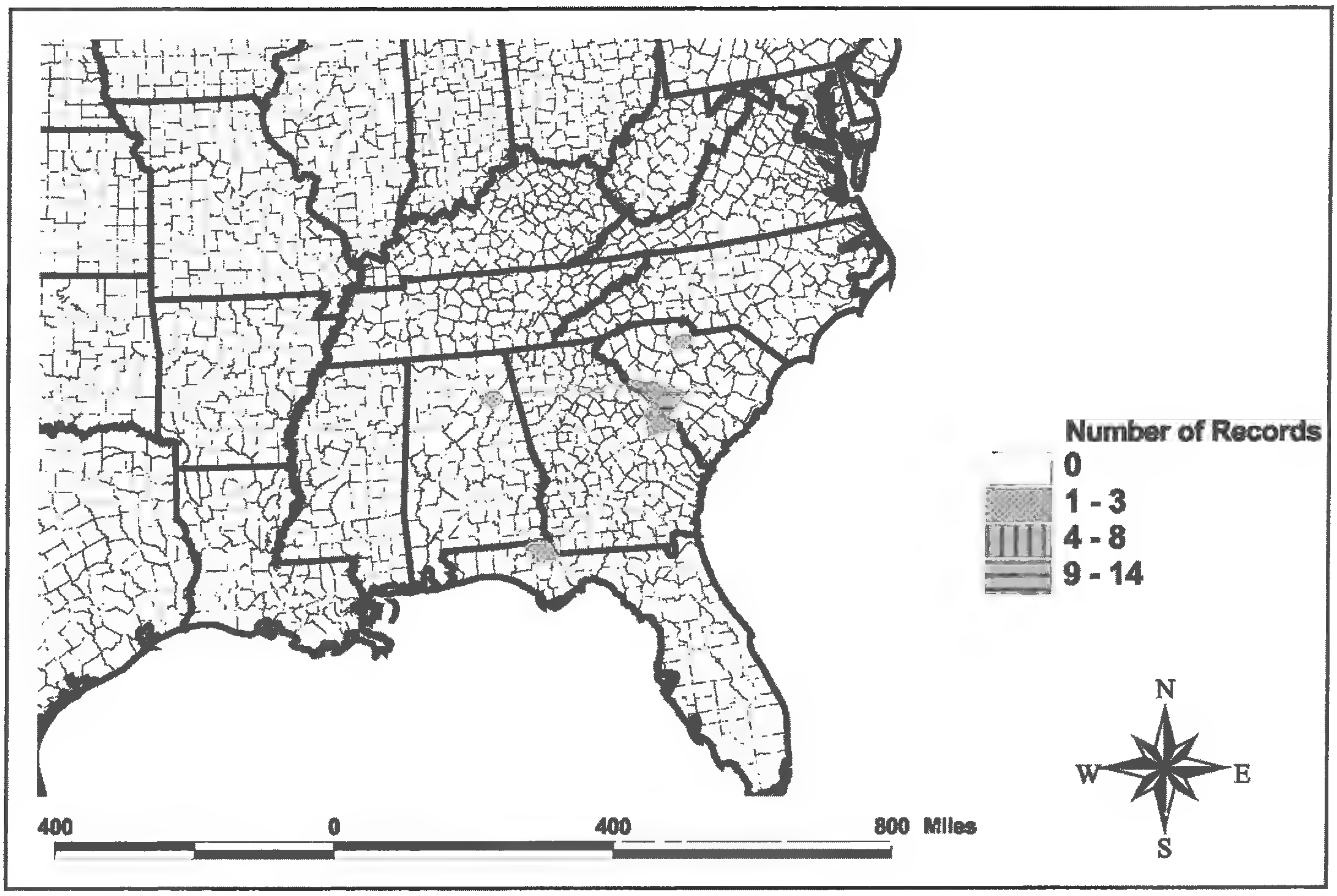

Fig. 33. County level distribution map of *Crataegus. dispar*.

mens lacking reproductive parts but otherwise adequate and sometimes from elongation shoots alone. Of note are the broad extension-shoot leaves which are often deeply incised into widely spreading, sharp segments lobed nearly to the sinuses, rather as in *C. marshallii*. The interesting foliage of this plant, added to its attractive flowers and fruit, make it potentially a beautiful ornamental for the dry landscape.

IMPERFECTLY KNOWN TAXA

Crataegus exilis is mentioned here because it has fairly distinctive type material but little else is known about it. The other two are only known from Ashe's protologues and would need typification to validate them. However, authentic material has not been located.

23. Crataegus exilis Beadle, Biltmore Bot. Stud. 1:76. 1902. Type: U.S.A. Georgia. Dougherty Co.: Albany, 25 Aug 1901, *C.D. Beadle 4093*² (lectotype, selected here: US).

Shrubs 2–4 m tall; bark of trunk rough; ultimate branches ± spreading (!); twigs at 1 yr old ± flexuous, color not recorded; extending twigs not recorded; thorns 1–1.5 cm long, straight, color not recorded. Leaves deciduous; petioles short, ca. 25–30% length of blade, pubescent, at least young; blades 1.5–2.5(–3) cm long, ± cuneate-obtrullate and very sharply lobed and toothed at anthesis, broad obovate to broad rhombelliptic in general shape, sides tapered into the winged upper part of the petiole; tip subacute; 0–1 blunt distal lobes per side, LII < 10%; margins with distal half crenatoserrate; pubescent at anthesis, particularly on the veins below, glabrous at maturity; venation craspedodromous, ca. 3 lateral veins per side; firm to subcoriaceous at maturity. Inflorescences 3–7-flowered; branches pilose-pubescent, bearing deciduous, oblong-linear, membranous, gland-bordered bracteoles; flowering early to mid-April. Flowers ca.15 mm wide; hypanthium externally pilose-pubescent; calyx-lobes 3–4 mm long, narrow-triangular, margins subentire to finely toothed, teeth glandular; petals ± circular, white; stamens 20, anthers cream or ivory; styles 3–5. Fruit 5–7 mm diam., globose, red; calyx-lobes usually erose; nutlets 3–5, dorsally grooved, sides plane.

Distribution.—On sandy soils and along streambanks in south-central Georgia.

The appearance of *C. exilis* is very distinctive but unfortunately it is known only from single flowering and fruiting syntypes. It somewhat resembles a larger *C. calva* (ser. *Apricae*) but has a merely pilose inflorescence, slightly different leaf shape and somewhat different margination.

Known only from protologues:

Crataegus cuthbertii Ashe, J. Elisha Mitchell Sci. Soc. 17:15. 1900.
Crataegus pearsonii Ashe, J. Elisha Mitchell Sci. Soc. 17:10. 1900.

APPENDIX OF CITED SPECIMENS

Arrangement alphabetical by species, state and county (number following county name is number of records for county).

Crataegus alabamensis Beadle
ALABAMA. Barbour Co.: (1) Eufaula NWR at old hwy. 165, 6 Apr 1993, *D. Drennan 82* (UWO). **Dallas Co.:** (4) Selma, 11 Apr 1912, *A. Cuthbert 4* (DOV); 8–10 mi E of Selma, 3 Oct 1998, *J.B. Phipps and R. Lance 7798* (UWO); Selma, 19 Apr 1920, *T.G. Harbison 15733* (NCU); near Selma, *T.G. Harbison s.n.* (NCC). **Montgomery Co.:** (4) Montgomery, 9 Aug 1899, *Biltmore Herb. 899* (A); Montgomery, 16 Aug 1900, *Biltmore Herb. 2168* (A, GH)); Montgomery, 15 Apr 1900, *Biltmore Herb. s.n.* (A). **FLORIDA. Leon Co.:** (7) near Tallahassee, 12 Apr 1931, *E.J. Palmer, 38560* (A); N side of Tallahassee, 27 March 1976, *L.C. Anderson 4133* (FLAS, FSU, GH); SW of Tallahassee, 24 May 1983, *R.K. Godfrey 80656* (UWO); Along Sharer Rd, S of I-10, 27 March 1983, *L. Anderson 4133* (UWO); 7 mi NW of Tallahassee, *W.A. Murrill s.n.* (FLAS). **GEORGIA. Baker Co.:** (1) Limesink Lake, 22 Aug 1977, *R. Kral s.n.* (UWO). **Richmond Co.:** (1) Augusta, 19 Jul 1900, *A. Cuthbert 4* (DOV). **SOUTH CAROLINA. Aiken Co.:** (1) no locality, 31 May 1882, *H.R. Ravenel 23* (MO). **Kershaw Co.:** (1) 0.1 mi E of Richland, 18 Jul 1958, *J.A. Duke 1487* (NCU).

Crataegus attrita Beadle
ALABAMA. Greene Co.: (2) Smith Lake area, 14 Apr 1969, *J.L. Thomas 1975* (ALU); Smith Lake, 18 May 1967, *H. Naugle s.n.* (ALU). **Coffee Co.:** (2) SE of Ella, 8 Jun 1968, *R. Kral 31417* (VBB, VDB). **FLORIDA. Washington Co.:** (2) 1 mi W of Millers Ferry, 3 Apr 1958, *R.K. Godfrey 56374* (DUKE, USF). **MISSISSIPPI. Lowndes Co.:** (1) Chitlin Corners area, 15 mi S of Columbus, W side of Tombigbee River, 16 Apr 1973, *W.C. Holmes s.n.* (NATC). **SOUTH CAROLINA. Chesterfield Co.:** (1) Haw Ridge, 23 Apr 1933, *T.G. Harbison s.n.* (NCU).

Crataegus colonica Beadle
NORTH CAROLINA. Bladen Co.: (3) W shore of White Lake, 10 Jun 1948, *W.B. Fox s.n.* (NCSC); On Big Turnbull Creek, 23 Aug 1953, *L. Melvin s.n.* (NCU); 1 mi W of White Lake, 1 May 1969, *R.L. Wilbur 10747* (DUKE). **Cumberland Co.:** (6) Route 87, 5 mi SE of I-95, 4 Jul 1981, *J.B. Phipps 511* (UWO); 700m S of Mileport 36 on I-95, S of Fayetteville, 18 Aug 1993, *J.B. Phipps 6766* (UWO); 400m S of Mileport 36 on I-95, S of Fayetteville, 18 Aug 1993, *J.B. Phipps 6765* (UWO); Exit 40 of I-95 and US 301, SW corner, 18 Aug 1993, *J.B. Phipps 6764* (UWO); Exit 40 of I-95 and US 301, SW corner, 6 Apr 1991, *J.B. Phipps 6511* (UWO); 15 mi S of Fayetteville, 16 Sep 1936, *E. Wherry s.n.* (A). **Robeson Co.:** (13) 3.5 mi SSW of St. Paul's, 20 Sep 1964, *R.F. Britt 3052* (AUA, CM, 2*DHL, KY, LAF, LYN, NC, 2*USCH, WVA, WILLI); I-95 N of exit 33, 10 Aug 1993, *J.B. Phipps 6671* (UWO). **Sampson Co.:** (2) 1.1 mi NNW of Waycross, 28 Jun 1857, *J. Haesloop 30133* (NCU); no locality, 28 Apr 1933, *T.G. Harbison s.n.* (NCU). **Wilson Co.:** (1) 2.4 mi SSW of Black Creek, 21 Jun 1958, *A.E. Radford 35726* (NCU). **SOUTH CAROLINA. Beaufort Co.:** (1) Bluffton, 1882, *G. Engelman 22359* (MO). **Lexington Co.:** (2) Route 302, SW of Edmund, 10 Apr 1991, *J.B. Phipps 6502* (UWO); US 321, 2 km S of I-26, W side road, 20 Aug 1992, *J.B. Phipps 6576* (UWO).

Crataegus condigna Beadle [excluding Alabama records identified as *C. insidiosa*]
FLORIDA. Alachua Co.: (5) 7 mi N of Gainesville, 8 Aug 1972, *S.T. Anderson 57* (FLAS); Gainesville, 27 Aug 1940, *W.A. Murrill s.n.* (A); E of Gainesville, 2 Apr 1940, *W.A. Murrill s.n.* (FLAS); Gainesville, 17 Aug 1940, *W.A. Murrill s.n.* (FLAS); Gainesville, 2 Jun 1940, *W.A. Murrill s.n.* (FLAS). **Columbia Co.:** (1) SE of Ft. White, 30 Mar 1956, *R. Kral 2188* (FSU). **Gadsden Co.:** (9) Aspalaga, no date, *Biltmore Herb. 297* (NCU); River Junction, 8 Sep 1897, *A.H. Curtiss 5982* (FLAS, CM, GA, GH, MO, NCU, NY); Aspalaga, 9 Sep 1950, *H. Kurz s.n.* (NCU). **Jackson Co.:** (1) 3.3 mi N of Marianna-Cottondale, 16 Sep 1950, *H. Kurz s.n.* (NCU). **Leon Co.:** (1) Tallahassee, no date, *T.G. Harbison 5461* (NCU). **Liberty Co.:** (1) no locality, 24 Mar 1951, *H. Kurz s.n.* (FSU). **Marion Co.:** (1) Gainesville, *30 Jun 1939, W.A. Murrill s.n.* (GA). **Suwannee Co.:** (2) 1 mi S of O'Brien, 3 Apr 1940, *W.A. Murrill & W.B. Tisdale s.n.* (FLAS, GA); 7 mi W of Live Oak, 21 Aug 1939, *Tisdale & W.A. Murrill s.n.* (FLAS). **Wakulla Co.:** (2) St. Marks, 12 Apr 1920, *T.G. Harbison 15699* (NCU); SW of jct. of US 98 and Co. Rd. 365, 21 May 1983, *R.K. Godfrey 80642* (UWO). **Washington Co.:** (1) 5 mi SE of Vernon, 31 may 1985, *L.C. Anderson 8192* (FSU). **GEORGIA. Chatham Co.:** (1) no locality, 21 Apr 1959, *E.O. Mellinger s.n.* (GH). **Columbia Co.:** (1) E of Harlem on 278, 18 Apr 1992, *J.B. Phipps 6557* (UWO). **Dougherty Co.:** (1) Albany, 18 Sep 1909, *W.W. Eggleston 5123* (MO). **Richmond Co.:** (6) Augusta, 16 Apr no year, *C.S. Sargent s.n.* (A); Augusta, 8 Apr 1919, *T.G. Harbison 41* (A); Augusta, 8 Apr

1919, *T.G. Harbison 14847* (NCU); Augusta, no date, *T.G. Harbison 6057* (NCU); Augusta, 11 Apr no year, *T.G. Harbison s.n.* (NCU); Augusta, 30 Sep 1900, *A. Cuthbert s.n.* (FLAS). **Screven Co.:** (1) 1 mi N of Statesville, 4 Sep 1968, *R. Lazor, R.K. Godfrey and J. Lazor 1067* (FSU). **NORTH CAROLINA. Carteret Co.:** (2) Lennox Point, E of Beaufort, 12 Sep 1947, *H.T. Scofield, L.A. Whitford and W.B. Fox 1167* (NCSC); Lennox Point, 16 Jul 1965, *M. Creech s.n.* (DUKE). **Craven Co.:** (2) New Bern, 17 Apr 1918, *T.G. Harbison 14065* (NCU); 2.8 mi E of Ft. Barnwell, 9 Jun 1958, *A.E. Radford 37668* (NCU). **Duplin Co.:** (1) 2.6 mi NE of Magnolia, 27 Apr 1957, *H.E. Ahles 24052 & G. Ramseur* (NCU). **Florence Co.:** (1) E of Clausen, 24 May 1957, *C.R. Bell 7529* (USF). **Lenoir Co.:** (2) 2 mi W of La Grange, 22 Jun 1957, *A.E. Radford 25681* (NCU); 2 mi W of La Grange, 6 May 1957, *A.E. Radford 22117* (NCU). **McDowell Co.:** (1) 1 mi SE of jct. NC 264 and US 221, 1 Sep 1956, *H.E. Ahles 17770* (NCU). **Moore Co.:** (1) 2 mi E of Carthage, 25 Apr 1948, *W.R. Fox & R.K. Godfrey* 1382 (NCSC). **New Hanover Co.:** (1) 4 mi W of Wilmington on road to Elizabethtown, 26 Apr 1936, *W.C. Coker s.n.* (NCU). **Polk Co.:** (1) Columbus, 20 Aug 1921, *D.C. Peattie 1329* (NCU). **Sampson Co.:** (1) 3.8 mi E of Falcon, 5 May 1957, *H.E. Ahles & H. Laing 24548* (NCU). **Wayne Co.:** (1) 4 mi W of Pikeville, 29 Apr 1956, *J. Rose 56* (NCU). **SOUTH CAROLINA. Aiken Co.:** (5) no locality, Apr 1890, *H.W. Ravenel 3* (A); near Windsor, 14 Apr 1932, *E.J. Palmer 39877* (A); no locality, 21 Apr 1880, *H.W. Ravenel s.n.* (A); no locality, 12 Sep 1909, *W.W. Eggleston 5048* (MO); no locality, 31 Mar 1952, *W.R. Kelley & W.T. Batson s.n.* (USCH). **Allendale Co.:** (1) SC 3 at 8.1 km S of US 301, 19 Apr 1992, *J.B. Phipps 6565* (UWO). **Bamberg Co.:** (1) SW of Govan, 6 Apr 1957, *H.E. Ahles & J.G. Haesloop 22207* (NCU). **Barnwell Co.:** (1) no locality, 31 Mar 1952, *W.R. Kelley & W.T. Batson s.n.* (USCH). **Berkeley Co.:** (1) West side of county, 7 Apr 1957, (NCU) *H.E. Ahles & J.G. Haesloop 22390* (NCU). **Calhoun Co.:** (2) no locality, no date, *H.B. Mooney & T.H. Stork s.n.* (USCH); 2 mi N of St Matthews, 31 Mar 1957, *H.E. Ahles & J.G. Haesloop 21751* (NCU). **Cherokee Co.:** (1) 0.4 mi N of Blacksburg, 0.5 m W SW of jct. US 29 & Co. Rd. 52, 18 Sep 1957, *H.E. Ahles 34198* (NCU). **Chester Co.:** (1) 3 mi E of Leeds, 20 Apr 1957, *O.M. Freeman 57143* (NCU). **Chesterfield Co.:** (4) Sugar Loaf Mountain, 13 May 1932, *B.E. Smith s.n.* (NCU); Jct. US 1 and Co. Rd. 20, S of Cheraw, 16 May 1976, *J.C. Solomon 1951* (CM); SW of Cheraw, 16 May 1976, *D.E. Boufford 18306* (MO); Haw Ridge, near McBee, 3 Apr 1935, *V. Matthews & B.E. Smith s.n.* (USCH). **Dillon Co.:** (1) 2.6 mi NW of Smithboro, 18 Apr 1957, *G. Ramseur & H.E. Ahles 23300* (NCU). **Florence Co.:** (2) E of Clausen, 24 May 1957, *C.R. Bell 7529* (NCU, USF). **Hampton Co.:** (1) SC 3 at 25.2 km S of US 301, 19 Apr 1992, *J.B. Phipps 6563* (UWO). **Lexington Co.:** (3) no locality, Mar 1963, *W.R. Kelley & W.T. Batson s.n.* (USCH); US 32, abt. 2 km S of I-26, 20 Apr 1992, *J.B. Phipps 6577* (UWO); US 321 0.5 km S of US 30, Allen Valley Rd., 20 Apr 1992, *J.B. Phipps 6578* (UWO). **Marlboro Co.:** (1) 4 mi S of NC state line, 4 Jun 1958, *J.A. Duke 892* (NCU). **Orangeburg Co.:** (3) US 178, 5.6 mi NW of Orangeburg, 30 Mar 1957, *H.E. Ahles & J.G. Haesloop 21561* (FLAS, NCU); W of Copeland, 26 Sep 1957, *H.E. Ahles & J.G. Haesloop 35116* (NCU). **Richland Co.:** (1) near Columbia, 19 May 1934, *E.J. Palmer 42411* (A).

Crataegus crocea Beadle

ALABAMA. Dallas Co.: (1) Rte. 140, Mt. Carmel Church, 8–10 mi E of Selma, 3 Oct 1998, *J.B. Phipps & R. Lance 7806* (UWO). **Pike Co.:** (4) 5 mi SE of Troy, 29 Sep 1979, *S McDaniel and C Duncan 22940* (ALU, FSU, GA, IBE). **FLORIDA. Alachua Co.:** (36) W of Gainesville, 22 Mar 19??, *W.W. Ashe s.n.* (FSU); near Gainesville, N of Sevenville, 01 Aug 1940, *W.A. Murrill s.n.* (FLAS, GA); Jct. of Fla 26 and Millhopper Rd., W side of Gainesville, 22 Mar 1968, *WG D'Arcy 2370* (FLAS, LAF, MO, NY, USF); W side of Payne's Prairie near Gainesville, 19 Jul 1940, *W.A. Murrill s.n.* (FLAS); Gainesville, 31 Jul 1940, *W.A. Murrill s.n.* (3*FLAS); Gainesville, 07 Apr 1931, *E.J. Palmer 38429* (MO); Gainesville, 21 Aug 1940, *W.A. Murrill s.n.* (FLAS); Gainesville, 02 Jul 1939, *W.A. Murrill s.n.* (2*A); Gainesville, 29 Jul 1939, *W.A. Murrill s.n.* (FLAS); Gainesville, 02 May 1941, *W.A. Murrill s.n.* (GA); Gainesville, 21 Jul 1940, *W.A. Murrill s.n.* (FLAS); Gainesville, 26 Feb 1982, *J.B. Phipps 5133* (UWO); Gainesville, 26 Feb 1982, *J.B. Phipps 5131* (UWO); Gainesville, 26 Feb 1982, *J.B. Phipps 5130* (UWO); Gainesville, 26 Feb 1982, *J.B. Phipps 5132* (UWO); Payne's Prairie Nature Reserve, 17 Aug 1993, *J.B. Phipps 6767* (UWO); Payne's Prairie Nature Reserve, 17 Aug 1993, *J.B. Phipps 6759* (UWO); Payne's Prairie Nature Reserve, 12 Mar 1993, *J.B. Phipps 6653* (UWO); Payne's Prairie Nature Reserve, 12 Mar 1993, *J.B. Phipps 6661* (UWO); Payne's Prairie Nature Reserve, 12 Mar 1993, *J.B. Phipps 6657* (UWO); Payne's Prairie Nature Reserve, 12 Mar 1993, *J.B. Phipps 6656* (UWO); Payne's Prairie Nature Reserve, 12 Mar 1993, *J.B. Phipps 6654* (UWO); Payne's Prairie Nature Reserve, 12 Mar 1993, *J.B. Phipps 6763* (UWO); Payne's Prairie Nature Reserve, 12 Mar 1993, *J.B. Phipps 6658* (UWO); Payne's Prairie Nature Reserve, 12 Mar 1993, *J.B. Phipps 6659* (UWO); Kanapaha Rd., 0.5 mi from end, 12 Mar 1993, *J.B. Phipps 6670* (UWO); S.R. 346. SE of Archer, 12 Mar 1993, *J.B. Phipps 6665* (UWO); Rte. 24, SW of Kanapaha and 0.4 km SW of Rte. 127, 12 Mar 1993, *J.B. Phipps 6669* (UWO). **Citrus Co.:** (8) Rosehill 1 m N of Hernando Co., 21 Apr 1959, *G.R. Cooley and R.J. Eaton 6460* (FSU, GH, USF); 1 mi E of Holder, 26 Mar 1965, *J. Beckner 661* (FLAS); Citrus Springs, 10 Mar 1993, *J.B. Phipps 6636* (UWO); E side of US 41, abt. 3 mi N of Hernando at old bend in road, 10 Mar 1993, *J.B. Phipps 6638* (UWO); E side of US 41, abt. 3 mi N of Hernando at old bend in road, 10 Mar 1993, *J.B. Phipps 6639* (UWO); W side of US 41, S of Citrus Springs, 10 Mar 1993, *J.B. Phipps 6637* (UWO). **Clay Co.:** (12) Magnolia Springs, 09 Apr 1920, *T.G. Harbison 5674* (A); Green Cove Springs, 29 Jun 1939, *W.A. Murrill s.n.* (FLAS); Magnolia Springs, 09 Apr 1920, *T.G. Harbison 5677* (A); Hibernia, March 1869, *W.M. Canby s.n.* (GH); Magnolia Springs, 09 Apr 1920, *T.G. Harbison 5680* (A); Green Cove Springs, 26 Jun 1940, *E.D. Murrill s.n.* (A, MO); Green Cove Springs, 01 Apr 1941, *Watson and W.A. Murrill s.n.* (GA); Magnolia Springs, 09 Apr 1920, *T.G. Harbison 15670* (A); S.R. 16 on N side, 200 m W of side road south to Clay Co. Fairground, 11 Mar 1993, *J.B. Phipps 6643* (UWO); S.R. 16 on N side, 200 m W of side road south to Clay Co. Fairground, 11 Mar 1993, *J.B. Phipps 6641* (UWO); Penney farms and Green Cove Springs, 11 Mar 1993, *J.B. Phipps 6642* (UWO). **Dade Co.:** (1) SW 189 Ave and Mowry St, 18 Mar 1969, *G.N. Avery 609* (FLAS). **Dixie Co.:** (1) Old Town, 30 Mar 1920, *T.G. Harbison 5603* (A). **Gadsden Co.:** (3) no locality, 06 Sep 1940, *W.A. Murrill and W.B. Tisdale s.n.* (FLAS); Open pineland, 0.75 mi W of Rosedale, 15 Sep 1983, *R.K. Godfrey 80955* (UWO); 1.4 mi from Dellwood, 25 Apr 1983, *R.K. Godfrey 80559* (UWO). **Gilchrist Co.:** (3) Between Newberry and Trenton, 11 Mar 1975, *R.K.*

Godfrey 74173 (2*FSU, MO). **Hardee Co.:** (1) 10 mi W of Bowling Green, 22 Jul 1977, *E. Kuczynski s.n.* (USF). **Hernando Co.:** (3) Chinsegut Hill, 18 Mar 1958, *J. Monachino and G.R. Cooley 5644* (USF); Brookesville along Crystal River Rd, 12 Mar 1936, *H.H. Hume s.n.* (FLAS); In pine-oakwoods SW Florida Water Management District lands, 8 mi S of Brooksville, no locality, 15 Mar 1977, *T.F. Rochow s.n.* (USF). **Hillsborough Co.:** (12) Tampa, USF campus, 02 Aug 1961, *O. Lakela 24519* (FLAS, FSU, GH); Tampa, USF campus, 11 Mar 1961, *O. Lakela 23807* (FLAS, FSU, GH); Tallahassee, 04 Apr 1923, *T.G. Harbison 6073* (A); USF Ecology area, 16 Mar 1983, *D. Richardson 901* (USF); USF Campus, 14 Apr 1963, *Students s.n.* (USF); E side of USF campus Tampa, 25 Mar 1961, *O. Lakela 23925* (USF); no locality, Jun 1971, *O. Lakela 32160* (USF); Tampa, campus of South Florida University, 8 Mar1993 *J.B. Phipps 6639* (UWO). **Jackson Co.:** (4) Dellwood, 28 Jun 1972, *R.K. Godfrey 71431* (FLAS, FSU); Marianna, 15 Mar 1937, *L.E Arnold and E. West s.n.* (FLAS); Chattahoochee, 03 Apr 1900, *C.S. Sargent s.n.* (DOV). **Kershaw Co.:** (1) US 1, 8 km SW of lights at Bethura, 6 Apr 1991, *J.B. Phipps 6505* (UWO). **Lafayette Co.:** (2) 4 mi W of Mayo, 21 Aug 1939, *W.A. Murrill and W.B. Tisdale s.n.* (2*FLAS). **Lake Co.:** (2) Tavares, 22 Mar 1901, *Biltmore Herb. 4020* (A); Tavares, 15 May 1900, *A.H. Curtiss 6617* (GH). **Leon Co.:** (7) Along Sharer Rd., N side of Tallahassee, 27 Mar 1976, *L.C. Anderson 4133* (FLAS); Tallahassee, 06 Apr 1920, *T.G. Harbison 5464* (A); near Tallahassee, 09 Apr 1929, *E.J. Palmer 35213* (2*A); W end of W Campus FSU, 09 Mar 1950, *H Kurz s.n.* (FSU); Tallahassee, 27 Mar 1977, *R.K. Godfrey 75772* (FLAS, FSU). **Liberty Co.:** (3) Tallahassee, 12 Apr 1972, *P. Elliot 224* (FSU); Torreya State Park, 04 Jul 1972, *R.K. Godfrey 71510* (FLAS); Torreya State Park, 22 Mar 1982, *R.K. Godfrey 79452* (FSU). **Live Oak Co.:** (1) no locality, 13 Apr 1900, *S.M. Tracy 6851* (MO). **Madison Co.:** (6) Ellaville, 21 Aug 1939, *W.A. Murrill and W.B. Tisdale s.n.* (3*FLAS); near Ellaville, 05 Sep 1940, *W.A. Murrill and W.B. Tisdale s.n.* (FLAS, GA); Ellaville, 21 Aug 1939, *E.J. Palmer s.n.* (A). **Marion Co.:** (22) N side of road near Citra, 26 Jul 1940, *W.A. Murrill s.n.* (FLAS); 8 mi S of Ocala, 23 Jun 1983, *N.L. Mawhinney 234* (USF); Citra, 13 Jun 1940, *W.A. Murrill s.n.* (FLAS); Cherryhill, 29 May 1942, *J.R. Watson s.n.* (FLAS); Citra, 26 Jul 1940, *W.A. Murrill s.n.* (FLAS); Citra, 10 Aug 1939, *W.G. Murrill and Hixon* (sp?) *s.n.* (FLAS); 4 mi W of Ocala, 28 Mar 1958, *G.R. Cooley and R.J. Eaton 5756* (GH, USF); E part of Ocala, 17 Jun 1940, *W.A. Murrill s.n.* (FLAS); Ocala, 20 Aug 1901, *Biltmore Herb. 134007* (GH); Ocala, 21 Mar 1901, *Biltmore Herb. 134007* (GH); Ocala, 06 Apr 1929, *E.J. Palmer 35171* (A); Dunnellon, 11 Aug 1940, *W.A. Murrill s.n.* (FLAS); near Citra, 02 Apr 1941, *W.A. Murrill s.n.* (GA); Citra, 02 Apr 1941, *W.A. Murrill s.n.* (FLAS); Citra, 21 Aug 1901, *Biltmore Herb. 4038* (GH); Citra, 22 Mar 1901, *Biltmore Herb. 4038* (GH); Citra, 13 Jun 1940, *Watson and W.A. Murrill s.n.* (FLAS); 1 mi NNE of Dunellon, 10 Apr 1993, *J.B. Phipps 6633* (UWO); 1 mi NNE of Dunellon, 10 Apr 1993, *J.B. Phipps 6635* (UWO); 1 mi NNW of Dunellon, W of US 41, S of humpback bridge, 10 Apr 1993, *J.B. Phipps 6634* (UWO); 1 mi NNW of Dunellon, W of US 41 at the humpback bridge, 13 Apr 1993, *J.B. Phipps 6644a* (UWO). **Ocala Co.:** (3) 3 mi S of Ocala, Aug 1939, *W.A. Murrill s.n.* (A); no locality, August 1901, *Biltmore Herb. R4007* (A); no locality, Mar 1901, *Biltmore Herb. R4007* (A). **Orange Co.:** (6) Apr 1923, *G.K. Jennings and O.E. ?? s.n.* (CM); Along US441, 2 mi SW of 2 Ellwood, 31 Mar 1977, *L. Baltzell 9408* (FLAS); 1 mi W of US hwy. 441 and State hwy. 421, 07 Mar 1965, *I.L. Wiggins 19357* (FLAS); 1 mi S of Ocoee SE corner of Lake Apopka at NE corner of jct. of Fla 50 C-526 and C-439, 20 Apr 1981, *R.P. Wunderlin and J. Beckner 8955* (USF); no locality, 16 Mar 1924, *F.W.H. 8965* (GH); Orlando 24 May 1929, *W.C. Edwards s.n.* (FLAS). **Osceola Co.:** (2) Kissimmee Township 27, 01 Mar 1938, *M.L. Singletory s.n.* (DUKE); N side of Fla 532, 1.5 mi E of Interstate 4 NW of Loughman, 04 Jul 1977, *A.G. Shuey 1942* (USF). **Pasco Co.:** (1) 2.5 mi E of hwy. 41 and 54, 25 Mar 1961, *G.M. Riegler 23895* (USF). **Polk Co.:** (3) W of Bartow, 08 Jun 1931, *J.B. McFarlin 6391* (A, FLAS); 3 mi NNW of W Frostproof, 9 Apr 1993, *J.B. Phipps 6630* (UWO). **Suwanee Co.:** (2) 7 mi W of Live Oak, 21 Aug 1939, *W.A. Murrill and W.B. Tisdale s.n.* (A); Hildreth, 10 Jul 1940, *W.A. Murrill s.n.* (FLAS). **Wakulla Co.:** (2) 1 mi S of Crawfordville by US Rte. 319, 25 Mar 1982, *R.K. Godfrey 79460* (IBE); near Wakulla River, 10 Apr 1931, *E.J. Palmer 38509* (A). **Walton Co.:** (1) Sand Hills, *Chapman s.n.* (NY). **?? Co.:** (1) no locality, no date, *Chapman s.n.* (NY). **GEORGIA. Bibb Co.:** (1) 7 mi SE of Macon, E side of State Rd 87, 12 Apr 1940, *W.H. Duncan 1906* (GA). **Calhoun Co.:** (1) Albany, 18–19 Sep 1909, *W.W. Eggleston 5117* (MO). **Charlton Co.:** (1) near Trader's Hill, 05 Aug 1959, *E Cypert s.n.*(GA). **Decatur Co.:** (5) Woods edge by hwy. 97 6 mi NE Bainbridge, 15 Jul 1976, *RA Norris 3178* (NATC); ¾ mi W of Brinson near Seminole Co. line, 31 Mar 1982, *R.K. Godfrey 79498* (2*FSU); Mt Pleasant community by Ga Rte. 97, 10 mi N of Bainbridge, 31 Mar 1982, *R.K. Godfrey 79497* (FSU, UWO). **Lowndes Co.:** (3) 4 mi NW of Hahira, 20 Jul 1965, *W.R. Faircloth 2476* (GA, MO, NCU). **Pulaski Co.:** (1) near Hawkinsville, 26 Jun 1902, *R.M. Harper 1374* (MO). **Screven Co.:** (1) 17.6 km N of Newington, 18 Apr 1992, *J.B. Phipps 6562* (UWO). **Talbot Co.:** (4) Rte. 90, 2 km ENE of Geneva, 9 Apr 1991, *J.B. Phipps 6483* (UWO); Rte. 90, 2 km ENE of Geneva, 9 Apr 1991, *J.B. Phipps 6480* (UWO); Rte. 96, abt. 1 mi E of Junction City, 9 Apr 1991, *J.B. Phipps 6493* (UWO); Rte. 96, 1 mi E of Junction City on S side of road, 9 Apr 1991, *J.B. Phipps 6490* (UWO). **Tatnall Co.:** (2) 2 mi W of Reidsville, 03 Apr 1948, *A. Cronquist 4949* (GH, MO). **NORTH CAROLINA. Cumberland Co.:** (2) NC53 and Co. Rd 2228, N of Jerome, 16 May 1976, *J.C. Solomon 5511* (CM, MO). **Johnston Co.:** (1) 2 mi S of Smithfield, 03 May 1940, *Radford and Stewart 152* (NCU). **SOUTH CAROLINA. Beaufort Co.:** (2) Bluffton, *J. Mellichamp s.n.* (NY); Bluffton, 1876, *J. Mellichamp s.n.* (NY). **Calhoun Co.:** (1) 4.3 mi ENE of St. Matthews, 14 Apr 1968, *S.W. Leonard 1264* (NCU). **Darlington Co.:** (1) Hartsville, 03 Sep 1909, *W.W. Eggleston 4932* (MO). **Kershaw Co.:** (1) near Camden, 19 Apr 1932, *E.J. Palmer 39956* (A). **Marlboro Co.:** (1) 12 mi N of Bennetsville near SC 38-166 jct., 30 Sep 1956, *A.E. Radford 18977* (NCU). **Richland Co.:** (1) 5335 Hardscrabble Rd., Blythewood, 08 Apr 1994, *D.F. Adcock 78* (USCH).

Crataegus dispar Beadle

ALABAMA. Etowah Co.: (1) Hinds Road Gadsden, 19 Sep 1999, *R. Lance s.n.* (UWO). **FLORIDA. Jackson Co.:** (1) Calhoun-Jackson Co. line 5 mi S of I-10, 21 Jun 1982, *R.K. Godfrey 79891* (UWO). **GEORGIA. Burke Co.:** (3) S of McBean and N of Crystal Lake Road, 13 Aug 1993, *J.B. Phipps 6706* (UWO); Route 56 N of intersection with 80 just N of Lake Crystal Road, 13 Aug 1993, *J.B. Phipps 6501* (UWO); S of McBean and N of Crystal Lake Road, 13 Aug 1993, *J.B. Phipps 6708* (UWO). **Clark Co.:** (1) Carlton

Woods, 20 Apr 1923, *Miller 3213* (GA). **Richmond Co.:** (3) Augusta, 31 Mar 1923, *T.G. Harbison s.n.* (NCU); Augusta, 11 Apr 1916, *W.W. Ashe 19* (2*NCU). **SOUTH CAROLINA. Aiken Co.:** (8) no locality, 3 Apr 1882, *H.W. Ravenel s.n.* (GH); 14 Apr 1885, *C.E. Flavian s.n.* (3*NY); SE of N Augusta, 12 Apr 1962, *H.E. Ahles and P.J. Crutchfield 56348* (NCU); Route 39 exactly 10.7 mi WNW of Wagener, 12 Aug 1993, *J.B. Phipps 6685* (UWO); US 278 1.7 mi E of SC 19, 12 Aug 1993, *J.B. Phipps 6686* (UWO); Route 39 exactly 10.7 mi NW of Wagener, 10 May 1991, *J.B. Phipps 6505* (UWO). **Chester Co.:** (2) where SC 72 crosses Broad Road, 4 Nov 1981, *J.B. Phipps 5127* (UWO); where SC 72 crosses Broad Road, 4 Nov 1981, *J.B. Phipps 5128* (UWO). **Edgefield Co.:** (1) 9 mi SSW of Trenton, 12 May 1957, *A.E. Radford 22501* (NCU). **McCormick Co.:** (1) Sumter National Forest SE of Clark, 16 Apr 1958, *H.R. Totten 1613* (NCC).

Crataegus egens Beadle
ALABAMA. Clark Co.: (1) no locality, 18 Jul, *C. Mohr s.n.* (MSC). **Henry Co.:** (1) Hwy. 95 S mm 46, 1 Mar 1993, *J.B. NELSON Drennen 74* (UWO). **FLORIDA. Alachua Co.:** (9) Gainesville, 21 Jul 1940, *W.A. Murrill s.n.* (FLAS); Gainesville, 25 Jul 1940, *W.A. Murrill and R.J. Wilmet s.n.* (FLAS); S.R. 346 SE of Archer fenceline, 12 Mar 1993, *J.B. Phipps 6664* (UWO); S.R. 346 SE of Archer fenceline, 12 Mar 1993, *J.B. Phipps 6662* (UWO); S.R. 346 SE of Archer fenceline, 12 Mar 1993, *J.B. Phipps 6663* (UWO); Gainesville, 26 Feb 1982, *J.B. Phipps 5129* (UWO); Rte. 24, SW of Kanapaha and 0.4 km SW of SW127 St. [CH], 12 Mar 1993, *J.B. Phipps 6668* (UWO); Gainesville, University of Florida Campus, 12 Mar 1993, *J.B. Phipps 6652* (UWO); University of Florida grounds, 24 Jun 1983, *R.K. Godfrey 80734* (FSU). **Clay Co.:** (23) Hibernia, Mar 1869, *W.M. Canby s.n.* (MO, NCU, 4*NY); Magnolia Springs, 9 Apr 1920, *T.G. Harbison 5673* (A); Magnolia Springs, 9 Apr 1920, *T.G. Harbison 15664* (NCU); Magnolia Springs, 23 Sep 1923, *T.G. Harbison 15673* (A, NCU); Magnolia Springs, 8 Apr 1920, *T.G. Harbison 15677* (NCU); Magnolia Springs, 9 Apr 1920, *T.G. Harbison 15775* (NCU); Magnolia Springs, 23 Sep 1923, *T.G. Harbison 5676* (A); Between Penny Farms and Green Cove Springs, 16 Aug 1993, *J.B. Phipps 6750* (UWO); Between Penny Farms and Green Cove Springs, 16 Aug 1993, *J.B. Phipps 6751* (UWO); Between Penny Farms and Green Cove Springs, 16 Aug 1993, *J.B. Phipps 6755* (UWO); Between Penny Farms and Green Cove Springs, 16 Aug 1993, *J.B. Phipps 6754* (UWO); Between Penny Farms and Green Cove Springs, 16 Aug 1993, *J.B. Phipps 6753* (UWO); Between Penny Farms and Green Cove Springs, 16 Aug 1993, *J.B. Phipps 6752* (UWO); Between Penny Farms and Green Cove Springs, 11 Mar 1993, *J.B. Phipps 6646* (UWO); Between Penny Farms and Green Cove Springs, 11 Mar 1993, *J.B. Phipps 6645* (UWO); Between Penny Farms and Green Cove Springs, 11 Mar 1993, *J.B. Phipps 6647* (UWO); Between Penny Farms and Green Cove Springs, 11 Mar 1993, *J.B. Phipps 6648* (UWO). **Duval Co.:** (3) Jacksonville, 1873, *C.E. Faxon s.n.* (GH); Old fields near Jacksonville, 1 Aug 1894, *A.H. Curtiss 4552* (UWO); Old fields near Jacksonville, 15 Mar 1894, *A.H. Curtiss 4552* (UWO). **Gadsden Co.:** (1) Aspalaga, 9 Sep 1950, *H. Kurz s.n.* (FSU). **Jackson Co.:** (2) 2 mi E of Grand Ridge, 27 Mar 1964, *S. McDaniel 4012* (IBE, FSU). **Lafayette Co.:** (4) Old Town, 20 Mar 1920, *T.G. Harbison 5611* (A, NCU); Old Town, 30 Mar 1920, *T.G. Harbison 5623* (A); Old Town, 30 Mar 1920, *T.G. Harbison 5610* (A). **Lake Co.:** (1) near Paisley, 25 Apr 1954, *E. Pritchard 690* (FSU). **Liberty Co.:** (6) Bristol, 23 Aug 1901, *Biltmore Herb. 4037* (A); Bristol, 21 Aug 1901, *Biltmore Herb. 6755* (GH); Bristol, 1 Apr 1901, *Biltmore Herb. 4037* (A); Bristol, 2 Apr 1902, *Biltmore Herb. 6023* (GH); Torreya Park, 24 Mar 1951, *H. Kurz s.n.* (FSU); Fla. Rte. 270 vicinity of Sweetwater community, 12 Apr 1982, *R.K. Godfrey 79569* (UWO). **Madison Co.:** (4) Ellaville, 5 Sep 1940, *W.A. Murrill and W.B. Tisdale* (FLAS); Ellaville, 3 Apr 1940, *W.A. Murrill and W.B. Tisdale* (FLAS); 13.9 mil E of Madison by US Rte. 90, 28 Apr 1982, *R.K. Godfrey 79687* (UWO); 13.9 mi E of Madison, 28 Apr 1982, *R.K. Godfrey 79688* (UWO). **Marion Co.:** (2) Ocala, Apr 1900, *M. Rodman s.n.* (USF); Citrus, 10 Aug 1939, *W.A. Murrill and Hixon* [?sp] *s.n.* (FLAS). **St. John's Co.:** (2) St. Augustine, Feb 1875, *M.C. Reynolds s.n.* (MO, NY). **Suwanee Co.:** (3) 1 mi E of Ellaville, 31 Mar 1957, *R. Kral 4363* (FLAS, FSU, LAF). **GEORGIA. Albany Co.:** (1) no locality, 22 Jun 1901, *H.C. Comtip s.n.* (NCU). **Camden Co.:** (1) 10 mi E of Folkston, 5 Apr 1941, *W.H. Duncan 3147* (GA). **Decatur Co.:** (1) 6 mi NE Bainbridge, 27 Aug 1948, *R.F. Thorne and W.C. Muenscher 8655* (GA). **Early Co.:** (1) no locality, 29 Jul 1946, *W.H. Duncan 6796* (A). **Emmanuel Co.:** (1) no locality, 30 Mar 1931, *E.J. Palmer 38270* (A). **Liberty Co.:** (1) near Hinesville, 24 Apr 1944, *W.C. Grimm s.n.* (CM). **Lowndes Co.:** (4) no locality, 27 Mar 1980, *K.D. Perkins and W. Judd 2596* (FLAS, FSU, WILLI, UWO). **Randolph Co.:** (1) N of Cuthbert, 28 Mar 1948, *R.F. Thorne and W.C. Muenscher 7688* (GA). **Schley Co.:** (1) Ken Brown Conservation Easement, 4 Jul 1993, *J.B. NELSON Drennen 83* (UWO). **Screven Co.:** (1) 6 mi NE of Newington, 17 Apr 1948, *A. Cronquist 5004* (GH). **Sumter Co.:** (1) NW of Americus, 30 Jul 1901, *R. Harper 1143* (MO). **Talbot Co.:** (3) 2 km ENE of Geneva, 13 Aug 1993, *J.B. Phipps 6725* (UWO); 2 km ENE of Geneva, 13 Aug 1993, *J.B. Phipps 6727* (UWO); 2 km ENE of Geneva, 9 Apr 1991, *J.B. Phipps 6485* (UWO). **Tatnall Co.:** (1) 2 mi W of Reidsville, 3 Apr 1948, *A. Cronquist 4949* (US). **Worth Co.:** (1) 3.7 mi NNW of Sylvester, 21 Aug 1966, *W.R. Faircloth 4030* (NCU). **SOUTH CAROLINA. Jasper Co.:** (3) 1.2 mi NE of junction of Co. Route 462, 24 Sep 1969, *S.W. Leonard and A.E. Radford 2778* (MO, NCU); S of Cypress Creek, E of S-219 and S-17, W of Grays, 8 May 1984, *C.A. Aulbach-Smith and J.B. Nelson 3080* (USCH).

Crataegus florens Beadle
ALABAMA. Barbour Co.: (1) no locality, 11 Aug 1927, *K.M. Wiegand and W.E. Manning 1356* (HUH). **Covington Co.:** (1) 2 mi W of Andalusia on US 84, 15 May 1970, *R. Kral 38517* (FSU). **Dallas Co.:** (8) Rte. 140, Mt. Carmel Church, 8–10 mi E of Selma, 3 Oct 1998, *J.B. Phipps and R. Lance 7803* (UWO); Rte. 140, 8–10 mi E of Selma near abandoned church, 10 Apr 1998, *J.B. Phipps 7686* (UWO); Rte. 140, 8–10 mi E of Selma near abandoned church, 10 Apr 1998, *J.B. Phipps 7685* (UWO); Rte. 140, 8–10 mi E of Selma near abandoned church, 3 Oct 1998, *J.B. Phipps and R. Lance 7801* (UWO); Rte. 140, 8–10 mi E of Selma near abandoned church, 3 Oct 1998, *J.B. Phipps and R. Lance 7802* (UWO); Rte. 140, 4.5 mi E of Selma, 10 Apr 1998, *J.B. Phipps 7681* (2*UWO); S outskirts of Selma, 15 Oct 1984, *J.B. Phipps 5484* (UWO). **Lowndes Co.:** (1) NE of Whitehall Holy Ground Battlefield Memorial Park, 10 Apr 1998, *J.B. Phipps 7678* (UWO). **Montgomery Co.:** (1) Beziel Springs Church Rd. S of Alabama 24 near Jack Creek,

1 Oct 1998, *J.B. Phipps and R. Lance 7785* (UWO). **Sumter Co.:** (1) Old Bluffport off S.R. 28 about 7 mi due E of Livingston along wooded tracks about ¾ mi back from Tombigbee, 11 Apr 1998, *J.B. Phipps 7696* (UWO). **Lee Co.:** (1) no locality, 1 Aug 1902, *T.G. Harbison 6665* (NY). **FLORIDA. Gadsden Co.:** (1) Fla Rte. 269, 23 May 1982, *R.K. Godfrey 79896* (UWO). **Hamilton Co.:** (1) Withlacoochee River at Fla. Rte. 6, 1 Oct 1950, *H. Kurz s.n.* (FSU).**Holmes Co.:** (1) Ponce de Leon, 11 Sep 1950, *H. Kurz s.n.* (FSU). **Jefferson Co.:** (1) Monticello, 26 Mar 1981, *L.H. Lighthipe s.n.* (NY). **Leon Co.:** (1) no locality, 10 Jul 1940, *W.A. Murrill s.n.* (FLAS). **GEORGIA. Baker Co.:** (1) no locality, 22 Aug 1977, *R. Kral 60870* (VDB). **Houston Co.:** (1) Along hwy. 129 about 8.8 mi N of Pulaski Co. line 0.8 mi S of Big Indian Creek Crossing, 10 Apr 2001, *R. Lance 2126* (UWO). **Liberty Co.:** (1) About the Altamaha River Swamp, 18 Jun 1895, *J.K. Small s.n.* (NY). **Lincoln Co.:** (2) no locality, 2 Sep 1940, *W.H. Duncan 2832* (2*NCSC). **Lowndes Co.:** (1) Coastal Plain Province, 28 Jun 1965, *W.R. Faircloth 1902* (MO). **Macon Co.:** (2) Just E of Oglethorpe on W side of Flint River, 8 Oct 1939, *W.H. Duncan 1750* (2*NCU). **Richmond Co.:** (1) Augusta, 2 Aug 1902, *A. Cuthbert s.n.* (FLAS). **Sumter Co.:** (2) no locality, 4 Jun 1976, *R.A. Norris 2863* (IBE, NATC). **Taylor Co.:** (1) Coastal Plain Province, 16 May 1974, *W.R. Faircloth 7530* (NCU). **LOUISIANA. West Feliciana Parish:** (1) 10 Aug 1916, *R.S. Cocks 4022* (NO). **MISSISSIPPI. Rankin Co.:** (1) South end of Ross Barnet Reservoir, 13 Apr 1984, *J.B. Phipps 7709* (UWO). **NORTH CAROLINA. Carteret Co.:** (1) Beaufort, *s.n.* (UWO). **Greene Co.:** (1) Sand ridge ca ½ mi NE of Browntown, 22 Jun 1960, *H.E. Ahles and J. Haesloop 53705* (NCU). **Lenoir Co.:** (1) Rte. 903 few mi S of La Grange, dirt driveway W side of road N of turkey farm, 18 Apr 1993, *J.B. Phipps 6768* (UWO). **Wayne Co.:** (1) 2.5 mi W of Lenoir Co. line, 14 Jul 1949, *W.B. Fox 2665* (NCSC). **SOUTH CAROLINA. Aiken Co.:** (2) 5 Aug 1898, *H. Egert s.n.* (2*MO). **Chesterfield Co.:** (2) near McBee, 18 May 1934, *E.J. Palmer 42382* (HUH); Haw Ridge near McBee, 17 Jul 1933, *T.G. Harbison s.n.* (NCU). **Clarendon Co.:** (1) Coclough Pond, 15 Sep 1939, *R.K. Godfrey and R.M. Tryon 1461* (NYBG). **Kershaw Co.:** (1) no locality, 3 May 1923, 3 May 1923, *T.G. Harbison 7028* (HUH). **Lexington Co.:** (1) About 1 mi N o US 178 S of Swansea, 11 Sep 1939, *J.B. Phipps 6675* (UWO). **Richland Co.:** (1) no locality, 1 Jul 1908, *W.W. Ashe s.n.* (NCU).

Crataegus floridana Sarg.
FLORIDA. Alachua Co.: (3) Gainesville, 31 Jul 1940, *W.A. Murrill s.n.* (FLAS); Rte. 24 SW of Kanapaha and 0.4 km SW of SW127 St., 12 Aug 1993, *J.B. Phipps 6666* (UWO); Paynes Prairie Nature Reserve, 17 Aug 1993, *J.B. Phipps 6761* (UWO). **Baker Co.:** (2) Lake City, 2 Apr 1923, *T.G. Harbison 6062* (A); Lake City, 7 Apr 1920, *T.G Harbison 5654* (A). **Citrus Co.:** (1) Pineola, 3 Apr 1930, *F.S. Blanton 7000* (GA). **Clay Co.:** (3) Magnolia Springs, 9 Apr 1920, *T.G. Harbison 5662* (A, NCU); High Land, 2 Jul 1929, *Hugh O'Neill s.n.* (FLAS). **Duval Co.:** (10) Jacksonville, March no year, *A.H. Curtiss 811* (CM, 2*GA, MO); Jacksonville, 25 Mar 1901, *A.H. Curtiss s.n.* (A); Jacksonville, 16 Jul no year, *A.H. Curtiss s.n.* (A); Jacksonville, 15 Aug 1901. *Biltmore Herb. 4076* (GH); Jacksonville, 17 Mar 1893, *A.H. Curtiss 4216* (MO); Jacksonville, 25 Mar 1902, *Bayutou s.n.* (FLAS); Jacksonville, *Biltmore Herb. 4067* (GH). **Gadsden Co.:** (2) Aspalaga, 5 Apr 1964, *S. McDaniel 4100* (IBE, FSU). **Gilchrist Co.:** (1) W of Newberry, 11 Jul 1940, *W.A. Murrill s.n.* (FLAS). **Hamilton Co.:** (2) 5.3 mi W of Jasper, 8 Jun 1950, *H. Kurz s.n.* (FSU); Floodplain Woods, 1 Oct 1950, *H. Kurz s.n.* (FSU). **Hernando Co.:** (1) Chinsegut Hill Wildlife Refuge, 3 Apr 1958, *G.R. Cooley and R. Eaton 5865* (FSU). **Levy Co.:** (1) near Chiefland, 7 Apr 1931, *J. Palmer 38435* (A). **Liberty Co.:** (1) Bristol, 7 Sep 1940, *W.B.Tisdale and W.A. Murrill s.n.* (FLAS). **Madison Co.:** (4) Ellaville, 3 Apr 1940, *W.A. Murrill and W.B. Tisdale s.n.* (FLAS); Cherrey Lake, 22 Aug 1940, *W.A. Murrill s.n.* (FLAS); 3.2 mi W of Co. line, 8 Apr 1961, *Barbara Moore 126* (FLAS); Ellaville, 21 Aug 1939, *W.A. Murill and W.B.Tisdale s.n.* (FLAS). **Marion Co.:** (3) Summerfield, 11 Aug 1939, *W.A. Murrill s.n.* (FLAS); S of Juniper Creek, 1 Sep 1941, *W. H. Duncan 4158* (GA); 1 mi NNW of Dunellon W of US41 at the humpbacked bridge at Chatmar, 15 Aug 1993, *J.B. Phipps 6743* (UWO). **Putnam Co.:** (1) 1 mi N of Orange Springs, no date, *W.A. Murrill s.n.* (FLAS). **Suwanee Co.:** (2) Luraville, 9 Aug 1946, *West and Arnold s.n.* (FLAS); Between US hwy. 90 and railroad, 23 Mar 1977, *D.L. Martin 993A* (FLAS). **GEORGIA. Baker Co.:** (1) SW of Newton, 20 Aug 1941, *W.H. Duncan 4116* (GA). **Bibb Co.:** (1) 13 mi SW of Macon, 24 Oct 1967, *R.L. Lane 1637* (NCSC). **Brooks Co.:** (1) 6 mi SW of Hyattville, 14 Jul 1965, *R. Dean and W. Faircloth 2181* (NCU). **Chattahoochee Co.:** (1) NE of Cusseta along Liberty Hill Rd., 20 Sep 1999, *R. Lance s.n.* (UWO). **De Kalb Co.:** (2) Stone Mt. near Yellow River, 15 Aug 1899, *A.H. Curtiss 6520* (A, GH). **Dougherty Co.:** (1) no locality, 19 Sep 1909, *W.W. Eggleston 5119* (MO). **Elbert Co.:** (1) S of Bowman, 11 Apr 1977, *R. and D. Coile 472* (GA). **Jefferson Co.:** (1) 0.2 mi NE of Ogeechee River, 26 Jul 1967, *J.R. Bozeman and J. F. Logue 10777* (NCU). **Lee Co.:** (2) McGuire's Mill, 2 Aug 1895, *J.K. Small s.n.* (A); N of Starkesville bridge over Muckalee Creek, 11 May 1940, *W.H. Duncan 2347* (FLAS). **Mitchell Co.:** (2) 0.2 mi E of Flint River, 29 Jun 1966, *J. Bozeman 5217* (NCU); no locality, 23 Aug 1940, *R. McVaugh 5248* (GA). **Richmond Co.:** (1) Augusta, 16 Apr 1923, *T.G. Harbison 7006* (A). **Sumter Co.:** (4) 10 mi NE of Americus, 25 Sep 1939, *W.H. Duncan 1670* (GA, NCU); 10 mi NE of Americus, 25 Sep 1939, *W.H. Duncan 1671* (GA, NCU). **Talbot Co.:** (8) Rte. 96 about 1 mi E of Junction City, 14 Aug 1993, *J.B. Phipps 6714* (UWO); Rte. 96 about 1 mi E of Junction City, 13 Aug 1993, *J.B. Phipps 6715* (UWO); Rte. 96 about 1 mi E of Junction City, 13 Aug 1993, *J.B. Phipps 6716* (UWO); Rte. 96 about 1 mi E of Junction City, 9 Aug 1993, *J.B. Phipps 6492* (UWO); Rte. 96 about 1 mi E of Junction City, 9 Aug 1993, *J.B. Phipps 6495* (UWO); Rte. 96 about 1 mi E of Junction City, 13 Aug 1993, *J.B. Phipps 6717* (UWO); Rte. 96 about 1 mi E of Junction City, 13 Aug 1993, *J.B. Phipps 6719* (UWO); 2 km ENE Geneva, 13 Aug 1993, *J.B. Phipps 6723* (UWO). **Tatnall Co.:** (1) 2 mi W of Reidsville, 21 Aug 1940, *W.H. Duncan 2729* (GA). **Terrell Co.:** (1) 2 mi SE OF Parrot, 8 Oct 1939, *W.H. Duncan 1756* (NCU). **Toombs Co.:** (1) Vidalia, Apr 1914, *M. Huger s.n.* (A). **Webster. Co:** (1) 1.3 mi W of Kinchafoonee Creek, 27 Jul 1966, *J.R. Bozeman 6728* (NCU). **Wilcox Co.:** (2) N of Abbeville, 7 Jul 2007, *J.R. Bozeman 5518* (2*NCU). **NORTH CAROLINA. Brunswick Co.:** (1) Smith Island, 29 Jul 1965, *A.W. Cooper 2856* (NCSC). **SOUTH CAROLINA. Kershaw Co.:** (1) 6 mi S of Cawdenon, 17 Jul 1933, *T.G. Harbison and H.R. Totten s.n.* (NCU).

Crataegus furtiva Beadle
ALABAMA. Barbour Co.: (2) Eufaula NWR, 05 Aug 1994, *D. Drennen 99* (UWO); Hwy. 431 S at Nat Guard Armoury 4 mi N of Eufaula, 18 Aug 1993, *D. Drennen 88* (UWO). **Coffee Co.:** (1) 1 mi S jct. AL 87 and US 84, 08 Jun 1968, *R. Kral 31417* (UWO). **Dallas Co.:** (5) 2 mi E of Selma, 11 Apr 1900, *C.S. Sargent s.n.* (A); Selma, 12 Apr 1912, *T.G. Harbison 10842* (NCU); Rte. 140 Mt Carmel church 8–10 mi E of Selma, 03 Oct 1998, *J.B. Phipps and R. Lance 7796* (UWO); 140 Mt Carmel Church 8–10 mi E o Selma, 03 Oct 1998, *J.B. Phipps and R. Lance 7800* (UWO); Rte. 140 8–10 mi E of Selma, 03 Oct 1998, *J.B. Phipps and R. Lance 7799* (UWO). **?? Co.:** (1) no locality, 14 Apr 1902, *T.G. Harbison 4114* (NCU). **FLORIDA. Alachua Co.:** (1) NE Alachua, 10 Aug 1993, *J.B. Phipps 6756* (UWO). **Lafayette Co.:** (1) 6 mi W of Branford, 11 Jul 1940, *W.A. Murrill s.n.* (FLAS). **Lake Co.:** (2) W side of Fla 19, 23 Mar 1981, *D. Richardson, R.P. Wunderlin and B. Hausen 8134* (2*USF). **Leon Co.:** (2) W of Tallahassee, 17 Mar 1982, *R.K. Godfrey 79429* (IBE); 1.5 mi W of Miccosukee, 07 Aug 1951, *H. Kurz s.n.* (FSU). **Liberty Co.:** (2) Bristol, 16 Mar 1890, *GSS 18* (NCU); Torreya State Park Entrance, 17 May 1983, *R.K. Godfrey 80627* (FSU). **Marion Co.:** (1) Ocala, 11 Aug 1939, *W.A. Murrill s.n.* (FLAS). **Sumter Co.:** (1) 3 mi S of Coleman, 02 Apr 1985, *B Hansen 10346* (USF). **Suwanee Co.:** (1) E of Suwanee River US 90, 28 Apr 1982, *R.K. Godfrey 79693* (UWO). **Wakulla Co.:** (1) St Marks, 25 Sep 1913, *T.G. Harbison 1209* (A). **GEORGIA. Ben Hill Co.:** (3) 1.5 mi S of Bowen Mill along US-129, 30 Jul 1964, *W.R. Faircloth 1433* (GA, MO, NCU). **Bibb Co.:** (3) 13 mi SW of Macon, 24 Oct 1967, *R.L. Lane 1637* (IBE); Bailey's Mill, 23 Apr 1898, *EF Andrews s.n.* (AUA); 10 Jun 1937, *AM Laessle s.n.* (GAM). **Burke Co.:** (3) River Rd at 18 km N of US 301, 19 Apr 1992, *J.B. Phipps 6569* (UWO); River Rd at 18 km N of US 301, 19 Apr 1992, *J.B. Phipps 6571* (UWO); River Rd at 18 km N of US 301, 12 Aug 1993, *J.B. Phipps 6701* (UWO). **Clarke Co.:** (2) Athens, 16 May 1925, *J.H. Miller* s.n. (GA); Athens, 16 Apr 1929, *K.M. Drewry E7783* (GA). **Colquitt Co.:** (1) 5 mi N of Doerum, 25 Aug 1990, *D. Drennen 24* (UWO). **Decatur Co.:** (4) 1 mi S of Faceville, 28 May 1983, *R.K. Godfrey 80661* (FSU); 4 mi N of Mt Pleasant Community, 31 Mar 1982, *R.K. Godfrey 79496* (FSU); 1 mi S of Faceville, 28 May 1983, *R.K. Godfrey 80662* (FSU); ¾ mi W of Brinson, 31 Mar 1982, *R.K. Godfrey 79498* (FSU). **Elbert Co.:** (1) S of Bowman, 11 Apr 1977, *N Coile 472* (NCSC). **Heard Co.:** (1) no locality, 29 May 1963, *J.C. Ware s.n.* (GA). **Gwinnett Co.:** (1) Mr. McGuire's Mill banks of Yellow road, 02 August 1895, *J.K. Small s.n.* (A). **Jefferson Co.:** (1) 1.2 mi S of Co. line along GA 17, 05 Aug 1966, *J.R. Bozeman 7071* (NCU). **Mitchell Co.:** (1) 3 mi SW of Hopeful, 23 Aug 1940, *R. McVaugh 5248* (A). **Richmond Co.:** (18) Augusta, 09 Apr 1919, *T.G. Harbison 43* (A); Augusta, 12 Apr 1901, *A. Cuthbert 402* (NCU); Augusta, 05 Apr 1914, *C.S. Sargent 520,* (2*A); Augusta, 31 Mar 1913, *T.G. Harbison 1038* (A); Augusta, 02 Apr 1900, *A. Cuthbert 4d* (NCU); Augusta, 10 Apr 1923, *W.W. Ashe s.n.* (NCU); Augusta, 15 Apr 1923, *T.G. Harbison 7002* (A); Augusta, 09 Apr 1919, *T.G. Harbison 51* (A); Augusta, 16 Apr 1923, *T.G. Harbison 7003* (A); Augusta, 07 Jul 1900, *A. Cuthbert 3* (DOV); Augusta, 31 Mar 1923, *T.G. Harbison 6058* (A); Augusta, 02 Apr 1913, *T.G. Harbison 1042* (A); Augusta, 09 Apr 1919, *T.G. Harbison 45* (A); no locality, 14 Aug 1958, *J.A. Duke 2025* (NCU); 10 mi E of Bath Rd, 14 Aug 1958, *J.A. Duke 2118* (NCU); Augusta, 04 Nov 1914, *T.G. Harbison 11* (A); Summerville near Augusta, 3 Oct 1914, *T.G. Harbison 1041* (A). **Meriwether Co.:** (1) 5 mi W of Greenville, 30 Apr 1961, *E.E. Terrell and A.S. Barclay 3414* (FSU). **Schley Co.:** (2) Ken Brown Conservation Easement 5 mi NW Ellaville, 01 Sep 1993, *D. Drennen 91* (UWO); Ken Brown Conservation Easement 5 mi NW Ellaville, 01 Sep 1993, *D. Drennen 92* (UWO). **Sumter Co.:** (1) Americus, Apr 1897, *A.W. Huger s.n.* (NY). **Talbot Co.:** (1) Rte. 96 1 mi E of Jct. City, 13 Aug 1993, *J.B. Phipps 6713* (UWO). **Tatnall Co.:** (1) 2 mi W of Reidsville, 03 Apr 1948, *A. Cronquist 4949* (GA). **Thomas Co.:** (1) Thomasville, Mar 1890, *Canby s.n.* (DOV). **Troup Co.:** (1) West Point, 12 Jun 1899, *s.n.* (NCU). **NORTH CAROLINA. Bladen Co.:** (1) Along big turnbull creek, 25 Aug 1993, *M. Lionel s.n.* (NCC). **Cumberland Co.:** (1) Steadman (across river), 20 Apr 1933, *T.G. Harbison and H.R. Totten s.n.* (NCU). **?? Co.:** (2) no locality, no date, *W.W. Ashe s.n.* (NCU); no locality, May 1938, *L. Hunt s.n.* (NCU). **SOUTH CAROLINA. Aiken Co.:** (7) near Windsor, 15 Apr 1932, *E.J. Palmer 39876* (A); 3 mi N of Aiken, 03 Apr 1939, *R.T. Clausen 3769* (A); Graniteville, 23 Apr 1899, *H. Eggert s.n.* (MO); near Windsor, 15 Apr 1932, *E.J. Palmer 39857* (A); 1.1 mi SW of Saluda-Aiken line, 11 Apr 1962, *H.E. Ahles and P.J. Crutchfield 56159* (NCU); 12–15 Sep 1909, *W.W. Eggleston 5064* (CM); US 278 ca 7 km E of jct. with SC 19, 03 Apr 1992, *J.B. Phipps 6574* (UWO). **Allendale Co.:** (4) 1 mi E of Martin, 11 Sep 1956, *C.R. Bell 5183* (GH, NCU, NY); no locality, 06 Apr 1953, *W.R. Kelley and W.T. Batson s.n.* (USCH). **Anderson Co.:** (3) 2.5 mi SE of Fair Play, 31 May 1956, *A.E. Radford 11992* (2*GA, NCU). **Barnwell Co.:** (2) Bowl State Park, 17 Oct 1956, *C.L. Porter 343* (USCH, UWO). **Calhoun Co.:** (1) 4.3 mi ENE of St Matthews, 14 Apr 1968, *S.W. Leonard 1264* (NCU). **Chesterfield Co.:** (1) US 1 and Co. 20 S of Cheraw, 16 May 1976, *J. Solomon 1951* (MO). **Clarendon Co.:** (1) no locality, 30 Jul 1982, *J.F. Logue 8L5635* (USCH). **Darlington Co.:** (2) Hartsville, 03 Jun 1941, *D.E. Smith 955* (NCU); 10 May1920, *A. Rehder 965* (A). **Edgefield Co.:** (1) 4.5 mi S of Trenton 01 Jun 1957, *A.E. Radford 26442* (NCU). **Kershaw Co.:** (4) 6 mi SW of Camden, 14 Jul 1933, *T.G. Harbison s.n.* (2*NCU); SW of Camden, 15 Jul 1933, *T.G. Harbison s.n.* (NCU); 6 mi SW of Camden, 17 Jul 1933, *T.G. Harbison s.n.* (NCU). **Lexington Co.:** (2) Bethel church, 13 Apr 1974, *D.E. Boufford 12808* (MO); 2 mi E of Edmund, 25 Apr 1980, *J.B. Nelson and W.T. Batson 1527* (FSU). **Richland Co.:** (2) E of Old Hartsville Guard, 05 Apr1991, *J.B. Nelson 10242* (USCH); 13.4 mi W of Camden, 14 Aug 1958, *H.E. Ahles and J.A. Duke s.n.* (NCU). **Sumter Co.:** (1) 5 mi WNW of Pinewood, 19 Apr 1957, *A.E. Radford 20984* (NCU). **?? Co.:** (1) Sandhills "A," 11 Jul 1952, *W.R. Kelley 419* (USCH).

Crataegus integra (Nash) Beadle
ALABAMA. Barbour Co.: (1) Lake Pt. State Park, 5 Jun 1992, *D.J. Drennan 00044* (UWO). **Calhoun Co.:** (1) Anniston Natural History Museum, 30 Aug 1998, *J.B. Phipps and D. Spaulding 7772* (UWO). **Dallas Co.:** (1) Rte. 140, 8–10 mi E of Selma, 10 Apr 1998, *J.B Phipps 7683* (UWO). **Macon Co.:** (1) 7.5 mi NE of Tuskegee, 20 Jul 1967, *Ross C. Clark 16456* (NCU). **Pike Co.:** (1) S of Brunridge, 17 Oct 1927, *W.W. Ashe s.n.* (NCU). **Tuscaloosa Co.:** (1) Jct. Kellytown Rd and Valley Rd, 23 Sep 1999, *J.B Phipps and*

R.J. O'Kennon 8071 (UWO). **FLORIDA. Alachua Co.:** (12) Hawthorn, 27 Feb 1933, *J.W. Kea s.n.* (FLAS); Gainesville, 7 Apr 1931, *E.J. Palmer 38416* (A); Gainesville, 25 Jul 1940, *Wilmot and W.A. Murrill s.n.* (FLAS, GA); Hawthorn, 4 Aug 1940, *Watson and W.A. Murrill s.n.* (FLAS); Gainesville, 6 Mar 1952, *G.R. Cooley 1443* (USF); Gainesville, 25 Sep 1940, *W.A. Murrill s.n.* (GA); Gainesville, 31 Mar 1940, *W.A. Murrill s.n.* (FLAS); Gainesville, 15 Jul 1936, *Survey Pasture s.n.* (FLAS); Gainesville, 17 Aug 1940, *W.A. Murrill s.n.* (FLAS); Gainesville, 12 Apr 1937, *W.A. Murrill s.n.* (FLAS); Paynes Prairie Nature Reserve, Chacala Trail, 21 Mar 1993, *J.B Phipps 6660* (UWO). **Baker Co.:** (2) near Macclenny, 24 May 1941, *W.A. Murrill s.n.* (GA); E side of Trail Bridge, 5 Jun 1936, *H.H. Hume s.n.* (FLAS). **Citrus Co.:** (4) 2 mi N of Pineola, 11 Mar 1956, *R. Kral 2069* (FLAS, FSU); Rose Hill, 21 Apr 1959, *G.R. Cooley 6460* (GH); 4 mi W of Hernando on SR486 at Anthony Ave., 15 Aug 1993, *J.B Phipps 6747* (UWO). **Clay Co.:** (2) Green Core Springs, 26 Jun 1940, *W.A. Murrill s.n.* (NCU); Green Core Springs, 26 Jun 1940, *J.R. Watson and W.A. Murrill s.n.* (NCU). **Columbia Co.:** (2) Lake City, 30 Jul 1927, *E. Manning 1350* (GH); 6 mi E of Branford, 1 Oct 1950, *H. Kurz s.n.* (FSU). **De Soto Co.:** (2) Old Pine Level Community Centre, 28 Aug 1976, *A.G. Shuey 1701* (2*USF). **Duval Co.:** (1) Jacksonville, 17 Mar 1893, *A.H. Curtiss 4216* (NY). **Escambia Co.:** (1) University of Fla. Grounds, 24 Jun 1983, *R.K. Godfrey 80734* (FSU). **Gadsden Co.:** (3) 6.8 mi E of Chattahoochee, 23 Apr 1967, *S. McDaniel 8757* (FLAS); 12 mi W of Quincy, 6 Sep 1940, *W.B. Tisdale and W.A. Murrill s.n.* (FLAS); 14 mi W of Quincy, 16 Sep 1940, *W.B. Tisdale and W.A. Murrill s.n.* (FLAS). **Hernando Co.:** (1) 6 mi N of Brooksville, 30 Jul 1961, *O. Lakela 24508* (USF). **Highlands Co.:** (4) Sebring, *J.B. McFarlin s.n.* (FLAS); Sebring, 9 Mar 1948, *R. Garrett s.n.* (GA); Sebring, 24 Jul 1949, *R. Garrett s.n.* (FLAS); NE of Sebring, 1 Aug 1948, *R. Garrett and L.E. Arnold 20* (FLAS). **Hillsborough Co.:** (5) 0.8 mi from Polk Co. line, 26 Mar 1961, *O. Lakela 23944* (FLAS, USF); Hillsborough River State Park, 3 May 1974, *S.M. Kreps s.n.* (USF); no locality, 3 Aug 1971, *O. Lakela 32161* (USF); Old Field, 13 Mar 1904, *A. Fredhold 6335* (GH). **Jackson Co.:** (3) Cottondale, 5 Apr 1923, *T.G. Harbison 6077* (A, NCU); N of Sneads, 10 Jun 1982, *R.K. Godfrey 79855* (UWO). **Lake Co.:** (10) no locality, 2 Apr 1978, *K. and J. Daubenmire 126* (USF); Eustis, 1–15 Jul 1894, *G. Nash 1142* (DOV, GH, MO); no locality, 28 Feb 1944, *F.W.H 17911* (GH); no locality, 13 Mar 1981, *R.P. Wunderlin 8880* (USF); Mt. Plymouth. 26 Nov 1960, *B. Moore s.n.* (FLAS); Leesburg, 17 Aug 1939, *Rude and W.A. Murrill s.n.* (FLAS); Eustis, 5 Aug 1901, *Biltmore Herb. 4022* (A); no locality, 14 May 1929, *W.W. Ashe s.n.* (NCU). **Leon Co.:** (2) E of Tallahassee, 23 Aug 1951, *H. Kurz s.n.* (FSU); 7 mi NW of Tallahassee, *W.A. Murrill s.n.* (FLAS). **Liberty Co.:** (2) Tallahassee, 6 Oct 1920, *T.G. Harbison 5711* (A); Tallahassee, 27 Aug 1902, *Biltmore Herb. 6043* (GH). **Madison Co.:** (3) Cherry Lake, 22 Aug 1940, *W.A. Murrill s.n.* (FLAS); Cherry Hill, 29 May 1942, *W.A. Murrill s.n.* (FLAS); near Ellaville, 5 Sep 1940, *W.B. Tisdale and W.A. Murrill s.n.* (FLAS). **Marion Co.:** (3) Summerfield, 11 Aug 1939, *W.A. Murrill s.n.* (FLAS); near Orange Springs, 7 Jun 1984, *R.F. Thorne 57941* (USF); 1 mi S of Reddick, 15 Sep 1940, *W.A. Murrill s.n.* (GA). **Orange Co.:** (8) 1.5 mi W of McDonald, 24 Feb 1918, *C. Barker 476* (3*A); 1.5 mi W of McDonald, 24 Feb 1918, *C. Barker 475* (A); 2 mi E of Zellwood, 7 Jul 1918, *C. Baker 476* (A); near McDonald, 7 Jul 1918, *C. Baker 474* (A); E of Mt. Dora, 17 Aug 1939, *W.A. Murrill s.n.* (FLAS); 1.5 mi N of Plymouth, 23 Apr 1982, *B. Hansen and D. Richardson 9608* (USF). **Polk Co.:** (9) Frostproof, 16 Mar 1949, *R. Garrett s.n.* (FLAS); Haines City, 17 Mar 1931, *J. McFarlin 4511* (A); 15 mi N of Lakeland, 28 Mar 1964, *R. Wall 34* (USF); Lake Hamilton, 26 Sep 1962, *H.S. Conrad s.n.* (FLAS); no locality, no date 1919, *Grace K. Jennings 6346* (CM); no locality, Dec 1919, *Grace K. Jennings s.n.* (UWO); Lake Hamilton, 17 Mar 1931, *E.J. Palmer 4447* (A); Haines City, 17 Mar 1931, *J. McFarlin 4510* (A); 3 mi NNW of West Frostproof, N of Xeriscape Nursery, 15 Aug 1993, *J.B Phipps 6748* (UWO). **Putnam Co.:** (9) near Edgar, 10 Nov 1940, *Watson and W.A. Murrill s.n.* (FLAS); 5 mi S of Melrose, 29 Mar 1942, *W.A. Murrill s.n.* (FLAS); near Cowpen Lake, 10 Nov 1940, *W.A. Murrill s.n.* (GA); Johnson, 9 Jun 1940, *W.A. Murrill s.n.* (FLAS); 0.8 mi W of Putnam Hall, 11 Mar 1993, *J.B. Phipps 6650* (UWO); 2 mi N of SR100 on SR309, 11 Mar 1993, *J.B. Phipps 6649* (UWO); 3.1 mi E of Melrose, 8 Jun 1982, *S. Humphrey 126* (FLAS); Cowpen Lake, 4 Aug 1940, *W.A. Murrill s.n.* (A); N side Putnam Hall, 11 Mar 1993, *J.B Phipps 6651* (UWO). **Sumter Co.:** (2) St. Catherine's Island, 25 Aug 1916, *T.G. Harbison 12707* (NCU); 1.5 km NE of Center Hill, 10 Mar 1993, *J.B Phipps 6640* (UWO). **Suwanee Co.:** (3) Branford, 21 Aug 1939, *W.B. Tisdale and W.A. Murrill s.n.* (FLAS); Hildreth, 10 Jul 1940, *W.A. Murrill s.n.* (A); Between Branford and Hildreth, 17 Mar 1939, *Exploration Party 1939* (FLAS). **Wakulla Co.:** (3) Tiger Hammock, 13 Aug 1951, *H. Kurz s.n.* (FSU); SW of jct. US Rte. 198 Co. Rd. 365, 21 May 1983, *R.K. Godfrey 80641* (UWO); SW of jct. US98 and Co. Rd.365, 21 May 1983, *R.K Godfrey 80643* (UWO). **?? Co.:** (3) no locality, Jun 1894, *A.S. Hitchcock s.n.* (MO); no date, *S.B. Buckley s.n.* (MO); no date, *A.W. Chapman s.n.* (NY). **GEORGIA. Decatur Co.:** (1) 6 mi NE of Bainbridge, 15 Jul 1976, *R.A. Norris 3178* (IBE). **Dodge Co.:** (1) NE of Little Ocomulgee, 6 Jul 1966, *J.R. Bozeman 5412* (NCU). **Houston Co.:** (1) no locality, 1 Jun 1979, *D. Dixon 1398* (NATC). **Jefferson Co.:** (2) 7 mi SW of Wrens, 20 Jun 1941, *W. Duncan 3370* (GA, NCSC). **Liberty Co.:** (6) 10 mi E of Taylor's Creek, 19 Aug 1940, *W. Duncan 2713* (A, DHL, 3*GA, NCSC). **Lowndes Co.:** (1) 5.5 mi NW of Valdosta, 3 May 1973, *W. R. Faircloth 7254* (MO). **Montgomery Co.:** (1) no locality, 8 Jul 1966, *J. R. Bozeman 5745* (NCU). **Randolph Co.:** (1) Cuthbert, 29 Jul 1928, *W.W. Ashe s.n.* (NCU). **Richmond Co.:** (3) Augusta, 31 Mar 1923, *T.G. Harbison 6059* (A); Augusta, 11 Apr, *T.G. Harbison s.n.* (NCU); Augusta, 25 Jul 1900, *Biltmore Herb. 2779* (DOV). **Terrell Co.:** (1) Hwy. 82 W of Graves, 1 Jun 1992, *D.J. Drennan 00041* (UWO). **Wayne Co.:** (1) On Altamaha River, 26 Jul 1941, *W. H. Duncan 3749* (GA). **Webster Co.:** (1) Negro Church, no date, *s.n.* (NCU). **SOUTH CAROLINA. Aiken Co.:** (2) no locality, 1 Aug 1952, *W.R. Kelly 23* (USCH); no locality, no date 1910, *W.W. Ravenel s.n.* (GH). **Barnwell Co.:** (1) 2 mi out of Barnwell, 15 Jul 1933, *T.G. Harbison s.n.* (NCU). **Beaufort Co.:** (3) no locality, 25 Aug 1916, *T.G. Harbison s.n.* (A); no locality, 31 May 1930, *E.J. Palmer 5496* (A); Ladies Island, 30 Apr 1917, *C.F. Batchelder 4868* (GH). **Calhoun Co.:** (1) 4.3 mi ENE of St. Matthews, 3 Jul 1957, *H.E. Ahles 30299* (NCU). **Lexington Co.:** (3) near Lexington, 19 May 1964, *N.D. Butler 3* (USCH); 2.2 mi NE of Lynches River, 24 Aug 1958, *J.A. Duke 2258* (NCU); W side US321, 1.8 km S of I-26, 11 Aug 1993, *J.B Phipps 6673* (UWO). **Richland Co.:** (1) no locality, 29 Jun 1964, *J.R. Russell 22* (USCH).

Crataegus invicta Beadle
GEORGIA. Appling Co.: (1) N side Big Satilla Creek, 9 Jun 1967, *J.R. Bozeman 9242* (NCU). **Berrien Co.:** (1) 3.2 mi W of Nashville, 4 May 1968, *W.R. Faircloth 5122* (GA). **Brooks Co.:** (4) 5.5 mi NNW of Quitman, 1 Jul 1965, *W.R. Faircloth 2005* (FSU, MO, NCC); 3 mi E of Quitman, 27 Jun 1966, *J.R. Bozeman 4902* (NCU). **Colquitt Co.:** (1) 5.4 mi W of Funston, 21 May 1973, *T. McCarty s.n.* (MO). **Early Co.:** (2) Railroad Station Scaffold off US Rte. 84, 1 May 1982, *R.K. Godfrey 79713* (FLAS, FSU). **Lanier Co.:** (4) no locality, 2 May 1956, *R. Kral 2493* (FSU); 7.8 mi NNE of Lakeland, 50 yards S of Mud Creek, 18 Jul 1966, *W.R. Faircloth 3579* (GA, MO, NCC). **Wayne Co.:** (1) 1.3 mi N of Glynn Co. line E of Mt. Pleasant, 21 Jul 1966, *J.R. Bozeman 6205* (NCC). **SOUTH CAROLINA. Allendale Co.:** (2) 0.1 mi NNE jct. Co. Rte. 49 and 26 on Co. Rte. 49, 13 May 1956, *H.E. Ahles and C.R. Bell 12522* (NCU, SC).

Crataegus lacrimata Small
ALABAMA. Autauga Co.: (1) near Prattville, 10 Apr 1966, *A.C. Koelling s.n.* (AUA). **Baldwin Co.:** (2) no locality, 21 Mar 1888, *C. Mohr s.n.* (ALU); Sandhills, 14 Oct 1923, *W.W Ashe s.n.* (NCU). **Dale Co.:** (1) near W boundary of Dale Co., 15 Apr 1931, *E.J. Palmer 38645* (A). **Dallas Co.:** (2) Selma, 11 Apr 1912, *T.G. Harbison 10831* (NCU); Selma, 10 Apr 1912, *T.G Harbison s.n.* (A). **Pike Co.:** (4) 5 mi SE of Troy, 29 Sep 1979, *S. McDaniel and C. Duncan 22940* (TENN); 5 mi ESE of Troy, 28 or 29 Sep 1966, *S. McDaniel 7805* (FSU, VDB); On hwy. 19, ¼ mi E of hwy. 223, 11 Sep 1986, *A.R. Diamond 2881* (AUA). **Russell Co.:** (2) 1 mi N jct. US 931 on Ala 169, 22 Jul 1968, *R. Kral 31806* (GA, UWO). **FLORIDA. Alachua Co.:** (3) W side of Gainesville, 22 Mar 1968, *W.G. D'Arcy 2370* (UWO); Payne's Prairie, Gainesville, 10 Aug 1940, *W.A. Murrill s.n.* (FLAS); SW of Payne's Prairie, Gainesville, 21 Aug 1940, *W.A. Murrill s.n.* (FLAS). **Bay Co.:** (22) 2 mi W of Rte. 231 jct. with FL Rte. 20., N of Youngstown, 14 Mar 1982, *R.K. Godfrey 79413* (FSU); 2 mi W of Rte. 231 jct. with FL Rte. 20 by Rte. 20, N of Youngstown, 14 Mar 1982, *R.K. Godfrey 79412* (FSU); 2.5 mi W of jct. FL Rte. 20 and US Rte. 231 by Rte. 20, 02 Apr 1982, *R.K. Godfrey 79509* (10*FSU); 1 mi W of Calhoun-Bay line by FL Rte. 20, W of Clarksville, 14 Mar 1982, *R.K. Godfrey 19411* (FSU); 1 mi E of Econfina Creek by FL Rte. 20, 14 Mar 1982, *R.K. Godfrey 19414* (FSU); Street perpendicular to Pearl Ave. Panama City Beach, 06 Nov 1982, *R.K. Godfrey 80187* (FSU, UWO); 1.8 mi W of jct. of FL Rte. 20 and US Rte. 231 by Rte. 20, 02 Apr 1982, *R.K. Godfrey 79508* (UWO); 1.8 mi W of jct. of FL Rte. 20 and US Rte. 231 by Rte. 20, 02 Apr 1982, *R.K. Godfrey 79507* (2*FSU, UWO); 8 mi N of jct. Fla. 20 along Fla. 231 2 mi S of Jackson Co. line, 11 Apr 1966, *J. Beckner and W. D'Arcy 993* (FLAS); 0.1 mi W of jct. with Fla. 77 on Fla. 20, 01 May 1982, *R. Wunderlin and J. Beckner 9325* (USF). **Calhoun Co.:** (2) 16 mi W of Altha, 10 May 1964, *S. McDaniel 4431* (FSU, IBE). **Escambia Co.:** (14) North Pensacola, 12 Jul 1969, *R.K. Godfrey 68622* (FSU); Univ. W FL campus grounds, 24 Jun 1983, *R.K. Godfrey 80734* (6*FSU); no locality, 07 Apr 1900, *C.S. Sargent 7665* (NY); near Pensacola, 14 Apr 1889, *C.S. Sargent s.n.* (A); Pensacola, 07 Apr 1900, *C.S. Sargent s.n.* (A, GH); Pensacola, 14 Apr 1894, *T.G. Harbison s.n.* (A); In Pensacola, opposite Bayview Mem. Cemetary, 18 Mar 1982, *Wilhelm 9980* (USF); 13 mi W of eastern gate of reservation on Santa Rosa Island, 30 Mar 1967, *C. and S. Chapman 0455* (FLAS). **Hillsborough Co.:** (3) Northeast border of USF campus, 09 Sep 1960, *J. Ray Jr. 10226* (USF); USF Campus, 11 Mar 1961, *O. Lakela 23807* (USF); USF Campus, 02 Ag 1961, *O. Lakela 24519* (USF). **Holmes Co.:** (1) Choctawatchee River, W of Millers Crossroad by FL Rte. 2, 17 Mar 1982, *R.K. Godfrey 79423* (FSU). **Levy Co.:** (1) By US Rte. 19 between Gulf Hammock and Lebanon Station, 26 Mar 1983, *R.K. Godfrey 80362* (FSU). **Liberty Co.:** (1) Torreya State Park, 04 Jul 1972, *R.K. Godfrey 71510* (FSU). **Marion Co.:** (2) Dunnellon, 11 Aug 1940, *W.A. Murrill s.n.* (FLAS); About 1 mi NNW of Dunnellon W of US 41, 15 Aug 1993, *J.B. Phipps 6744* (UWO). **Okaloosa Co.:** (70) Valparaiso, 09 Aug 1928, *W.W. Ashe s.n.* (NCU); 4.8 km N of US Rte. 90, 27 May 1973, *D.E. Boufford and H.E. Ahles 9484* (A); 1 mi. N of Deerland, 02 Aug 1954, *E.S. Ford 3886* (FLAS); 2 mi. NW of US 90 on FL Rte. 4, 20 Aug 1950, *H Kurz s.n.* (2*FSU); Valparaiso, 23 Mar 1927, *W.W. Ashe s.n.* (5*NCU); 3 mi N of Fort Walton, 02 Apr 1966, *R. Kral 26149* (FSU, GA, TENN, UWO); near Shoal River on US Rte. 90 and E of town of Crestview, 27 May 1973, *D.E. Boufford and H.E. Ahles 9492* (A); N of Niceville along FL 85, 19 Jun 1956, *Mr. and Mrs. H.A. Davis 11604* (WVA); 2 mi W of Laurel Hill, 02 Aug 1961, *R.K. Godfrey 61299* (FSU); 200 yds N of Rd 220 ca. 8 mi NNE of Niceville, 24 Aug 1966, *D.B Ward and C. Chapman 5987* (FLAS); 3.5 mi SW of Laurel Hill, 02 Aug 1961, *R.K. Godfrey 61316* (FSU); near jct. of Eglin Rd. 238 and Eglin Rd. 40, W of head of Rogue Creek, 22 Jul 1977, *K.D. Perkins with J.B. Nelson 340* (FLAS); 0.4 mi E of Shoal River on US 90, 21 May 1976, *J.C. Solomon 5621* (FSU); along Rte. 90 about 1 mi E of Shoal River, 27 Jul 1981, *D.S. Correll and H.B 52224* (USF); Jct. of US Rte. 90 and Shoal River, then 3 mi N on dirt road NE of Crestview, 27 May no locality, no date 1973, *H.E. Ahles with D.E. Boufford 77031* (CM); 17 mi NW of Ft Walton Beach, 10 May1967, *D.B. Ward, C. Chapman and R.R. Smith 6396* (FLAS, LAF, NCU); S of Shoal River on FL Rte. 87, 04 Jun 1951, *H. Kurz s.n.* (FSU); Milligan, 05 Apr 1949, *S.C. Hood 1829* (FLAS); 1 mi N of Niceville Center by FL Rte. 85, 02 Apr 1982, *R.K. Godfrey 79518* (FSU, UWO); N side of US 90 about 8 km E of Crestview 0.5 km W 4 lane hwy., 08 Apr 1991, *J.B. Phipps 6476* (UWO); 2.5 mi E of Niceville by FL Rte. 20, 02 Apr 1982, *R.K. Godfrey 79517* (FSU, UWO); rest area on I10 ca. 1 mi E intersection with hwy. 85 S of Crestview, 23 May 1989, *L.E. Brown 13628* (UWO); 1 mi N of Niceville Center by FL Rte. 85, 02 Apr 1982, *R.K. Godfrey 79519* (FSU, UWO); 3.4 mi E of Holt by US Rte. 90, 02 Apr 1982, *R.K. Godfrey 79521* (FSU, UWO); near Deerland, 27 Apr 1956, *R.K. Godfrey 54630* (DUKE, FLAS, FSU, NCU, UWO); US 90, 6 mi E of Crestview, 14 Aug 1993, *J.B. Phipps 6736* (UWO); US 90, 6 mi E of Crestview, 14 Aug 1993, *J.B. Phipps 6739* (UWO); US 90, 6 mi E of Crestview, 14 Aug 1993, *J.B. Phipps 6738* (UWO); US 90, 6 mi E of Crestview, 14 Aug 1993, *J.B. Phipps 6737* (UWO); US 90, 6 mi E of Crestview, 14 Aug 1993, *J.B. Phipps 6740* (UWO); US 90, 6 mi E of Crestview, 14 Aug 1993, *J.B. Phipps 6735* (UWO); N side of US 90 about 8 km E of Crestview 0.5 km W of 4 lane hwy., 08 Apr 1991, *J.B. Phipps 6475* (UWO); Hwy. 4 just S of Baker and 2.9 km NW of Milligan at US 90, 14 Aug 1993, *J.B. Phipps 6734* (UWO); Hwy. 4 just S of Baker and 2.9 km at Richmond Rd. and 2.9 km NW of Milligan at US 90, 04 Apr 1991, *J.B. Phipps 6473* (UWO); Hwy. 4 just S of Baker and 2.9 km at Richmond Rd. and 2.9 km NW of Milligan at US 90, 04 Apr 1991, *J.B. Phipps 6474* (UWO); Crestview rest stop on I10 E, 12 Jun 1989, *D.J. Drennen 20* (UWO); 4.6 mi E of Holt by US Rte. 90, 02 Apr 1982, *R.K. Godfrey 79520* (FSU, UWO); Milligan, 05 Apr

1949, *S.C. Hood 1831* (FLAS); Rte. 85, 2 mi SW of Valparaiso, 04 Apr 1975, *L.J. Uttal 10996* (NCU); 3 mi N of Ft. Walton, 02 Apr 1966, *R. Kral 26149* (IBE); Niceville, 28 Mar 1951, *E.L. Tyson 537* (FLAS); Rest area beside I-10 1 mi E of Shoal, 29 Mar 1975, *L.L. Anderson 3922* (FSU); W side of Rte. 85 ½ mi NE of bridge over Garnier Bayou, 15 Mar 1982, *G. Wilhelm 9945* (USF); Valparaiso, 23 Mar, *T.G. Harbison s.n.* (NCU); 1 mi NE of Ft. Walton, 11 Sep 1950, *H. Kurz s.n.* (FSU); 3 mi E of Shalimar and S of Fla 85, *J. Beckner and W. D'Arcy 1119* (FLAS); Crestview, 08 Apr 1899, *C.S. Sargent s.n.* (A); Valparaiso, 27 Mar 1918, *W.W. Ashe s.n.* (NCU); Valparaiso, 26 Mar 192, *W.W. Ashe s.n.* (NCU); Tallahassee, 12 Jun 1950, *H Kurz s.n.* (FSU); W of Crestview, 20 Apr 1982, *H.B. and D.S. Correll 53779* (NCU). **Santa Rosa Co.:** (6) 17 mi E of Pensacola on US Rte. 98, 11 Aug 1950, *H Kurz s.n.* (FSU); Rte. 87, 8.5 km S of I10, E side of road, 08 Apr 1991, *J.B. Phipps 6472* (UWO); 1 mi W of Wynn Haven Beach by US 98, 04 Apr 1982, *R.K. Godfrey 79562* (FSU, UWO); FL 87 8.5 km S of I10 E side of road, 14 Aug 1993, *J.B. Phipps 6733* (UWO); FL 87 8.5 km S of I10 E side of road, 14 Aug 1993, *J.B. Phipps 6732* (UWO). **Volusia Co.:** (2) Haw Creek, Seville, 16 Jul, *A.H. Curtiss 6203* (2*A). **Walton Co.:** (14) 3 mi. S of Mossy Head jct., 19 Jul 1966, *C. Chapman and G. Crosby and R.R. Smith 1069* (FLAS); Along FL 285, 2.8 mi SW of jct. UC Rte. 90, 14 Sep 1970, *D.B. Ward and J. Hunter 7421* (FLAS); S of US 98 W of Grayton Beach, 13 Jul 1971, *H.A. Davis 15687* (FLAS); FL 280, 4 mi S of Mossy Head, 24 Aug 1966, *D.B. Ward and C. Chapman 5998* (FLAS); 7 mi W of DeFuniak springs N of hwy. 90, 10 Aug 1957, *E.S. Ford 5289* (FLAS); along FL 285 ca. 3 mi S of jct. with US 90 at Mossy Head, 29 Jun 1966, *J. Beckner, C. Chapman and R.R. Smith 1353* (FLAS); 1 mi E of Sandestin Beach by US Rte. 98, 04 Apr 1982, *R.K. Godfrey 79563* (2*UWO); DeFuniak Springs, 14 Apr 1899, *T.G. Harbison s.n* (A); DeFuniak Springs, 14 Apr 1931, *E.J. Palmer 38619* (A, GH); near DeFuniak Springs, 14 Apr 1931, *E.J. Palmer 38617* (A, MO); 6.5 mi W of Portland, 11 Aug 1966, *C. Chapman 1258* (FLAS). **Washington Co.:** (3) on Orange Hill W of FL 273 and ca. 7 mi SE of Chipley, 16 Oct 1972, *D.B. Ward and N.E. Lee and A. Gholson s.n.*(FLAS); S of Chipley, West FL, 26 Mar 1928, *W.W. Ashe s.n.* (NCU); Holmes Valley, 26 Mar 1928, *W.W. Ashe s.n.* (NCU). **?? Co.:** (2) Nat. Forest near Wild Cat lookout trail, 26 Mar 1927, *W.W. Ashe s.n.* (NCU); Florida National Forest, 26 Mar 1927, *W.W. Ashe s.n.* (NCU). **GEORGIA. Chattahoochee Co.:** (1) Ft. Benning Military Res., 16 mi SE of Columbus, 03 Apr 1980, *R.R. Haynes 7665* (ALU). **Cherokee Co.:** (1) Canton Rd 140, RR3, Box 1180, 19 Apr 1984, *F.G. Meyer and P.M. Mazzeo 20064* (UWO). **Clarke Co.:** (1) near River by Bobbin Mill, 08 Apr 1930, *J.M. Reade E4634* (UWO). **Lanier Co.:** (1) 2.3 mi SSE of Lakeland, 26 Oct 1968, *G. Lloyd, N. Gillis and W.R. Faircloth 5653* (GA). **Lowndes Co.:** (1) 10 mi WSW Valdosta, 30 Aug 1968, *R.A. Norris 1051* (IBE). **Madison Co.:** (1) Danielsville 2 mi NE, 19 Aug 1927, *K.M. Wiegand and W.E. Manning 1357* (GH). **Randolph Co.:** (1) Cuthbert, 09 Sep 1928, *T.G. Harbison s.n.* (NCU). **Talbot Co.:** (4) Rte. 96, about 1 mi E of Junction City, 13 Aug 1993, *J.B. Phipps 6712* (UWO); Rte. 96, about 2 km ENE of Geneva, 09 Apr 1991, *J.B. Phipps 6488* (2*UWO); 2 km ENE of Geneva, 13 Aug 1993, *J.B. Phipps 6720* (UWO). **SOUTH CAROLINA. Aiken Co.:** (3) S.C. 391 11.2 mi S of Batesburg, 18 Jul 1958, *J.A. Duke 1512* (NCU); Woodlanders Nursery, 1128 Colleton Ave, 11 Apr 1984, *F.G. Meyer and P.M. Mazzeo 19864* (UWO); 1 mi E of Wagener, 24 Dec 1941, *W.C. Coker s.n.* (NCU). **Lexington Co.:** (1) Batesburg, 29 Apr 1911, *E.A. McGregor 609* (US). **Orangeburg Co.:** (1) 5 mi W of Orangeburg on US Rte. 301, 26 Sep 1957, *H.E. Ahles 35077* (NCU).

Crataegus lanata Beadle
ALABAMA. Barbour Co.: (2) Eufaula NWR at entrance of old hwy. 165, 06 Apr 1993, *D.J. Drennen 79* (UWO); Eufaula NWR at Baker Co. line, N boundary on old hwy. 165, 30 yrds E of fireline, 19 August 1993, *D.J. Drennen 90* (UWO). **Dallas Co.:** (3) Sardis, 20 Apr 1916, *R.S. Cocks s.n.* (NO); Sardis, 15 Apr 1918, *R.S. Cocks s.n.* (NO); Selma, 12 Apr 1912, *T.G. Harbison 842* (HUH). **Greene Co.:** (1) Entrance to Smith Lake, 14 Apr 1967, *T.D Naugle T995* (ALU). **Lee Co.:** (1) Phoenix City, 28 Sep 1906, *T.G. Harbison 10045* (NCU). **Russell Co.:** (2) Phoenix City, 26 Sep 1905, *T.G. Harbison 10044* (2*NCU). **Tuscaloosa Co.:** (1) Tuscaloosa, 05 Apr 1927, *W.W. Ashe s.n.* (NCC). **FLORIDA. Citrus Co.:** (11) 4.5 mi NE of Holder, 3 May 1981, *L. Baltzell and D.W. Hall 11387* (2*FLA, FLAS, WILLI); Withlacoochee State Forest, 27 May 1973, *P. Genelle and G. Fleming 1883* (GA, NCU, TENN, USF); Flora City, 19 Apr 1931, *E.J. Palmer 38393* (HUH); Pineola, 03 Apr 1930, *F.S. Blanton 7000* (2*HUH). **Columbia Co.:** (2) no locality, 21 Jul 1918, *T.G. Harbison s.n.* (HUH); Lake City, 21 Jul 1918, *T.G. Harbison 14576* (NCU). **Hernando Co.:** (4) Chinesgut Hill Wildlife Refuge, 03 Apr 1958, *G.R. Cooley and R.J. Eaton 5865* (USF); 0.7 mi S of Nobleton, 17 Jun 1976, *L. Baltzell and D.B. Ward 8620* (FLAS); 4 mi NE of Brooksville, 18 May 1965, *J. Beckner and D.B. Ward 4694* (FLAS, WILLI). **Jackson Co.:** (2) 1.4 mi W of Sneads, 19 May 1966, *R.K. Godfrey 67637* (FLAS, FSU). **Lake Co.:** (1) Vacant lot in Tavares, 15 May 2000, *A.H. Curtiss 6617* (DOV). **Liberty Co.:** (2) Telogia, 23 Jul 1940, *Arnold and West s.n.* (FLAS); Rock Bluff, 06 Aug 1927, *K.M. Wiegand and W.E. Manning 1355* (HUH). **Marion Co.:** (1) Summerfield, 11 Aug 1939, *W.A. Murrill s.n.* (FLAS). **Sumter Co.:** (1) Sumterville, 04 Apr 1946, *Arnold and West s.n.* (FLAS). **Suwanee Co.:** (1) Hildreth, 10 Jul 1940, *W.A. Murrill s.n.* (FLAS). **Washington Co.:** (1) 1 mi W of Miller's Ferry, 03 Apr 1958, *R.K. Godfrey 56374* (FSU). **Volusia Co.:** (1) Low woods bordering Haw Creek, 07 Jun 1900, *A.H. Curtiss 6677* (GA). **GEORGIA. Baldwin Co.:** (1) 5.3 km S of Co. line on US 441, 01 Jun 1973, *H.E. Ahles and D.E. Boufford 9693* (A). **Chattooga Co.:** (1) Summerville near Augusta, 03 Sep 1914, *T.G. Harbison 2=1041* (HUH). **De Kalb Co.:** (1) Bordering Yellow River near Stone Mt., 15 Aug 1899, *A.H. Curtiss 6520* (MO). **Gadsen Co.:** (1) 1 mi S of River Jct., 06 Sep 1940, *W.A. Murrill and W.B. Tisdale s.n.* (FLAS). **Gwinett Co.:** (8) McGuire's Mills, 11 Sep 1902, *Biltmore Herb. 7105* (2*GH); On the Yellow River near McGuire's Mills, 17 May 1895, *J.K. Small s.n.* (NY); Yellow River, 11 Sep 1902, *C.D.Beadle 7105* (Gray, HUH); Rocky woods near Stone Mt., 15 Aug 1899, *A.H. Curtiss 6519* (DOV, HUH); Rocky woods bordering Yellow River near Stone Mt., 15 Aug 1899, *A.H. Curtiss 6520* (MO). **Hart Co.:** (1) 5 mi SW of Hartwell, 20 May 1934, *E.J. Palmer 42445* (HUH). **Lee Co.:** (1) 3 mi SE of Smithville, 11 May 1940, *W.H. Duncan 2306* (GAM). **Lincoln Co.:** (1) 3 mi W of Liston, 02 Sep 1940, *W.H. Duncan 2832* (DUKE). **Long Co.:** (1) 0.5 mi N of Beard's Bluff, 10 Apr 1963, *J.R.Bozeman 2534* (NCU). **Lowndes Co.:** (3) 10.3 mi S of Valdosta, 28 Jun 1965, *W.R. Faircloth 1902* (2*GA, NCU). **Madison Co.:** (1) 2 mi W of Comer on S fork of the Broad River, 26 Apr 1942, *W.K. Duncan 4781* (GA). **Richmond Co.:** (9) 1.5 mi E of GA-56, 04 Aug 1966, *J. R. Bozeman 6952* (2*NCU); Summerville near Augusta, 3 Oct 1914, *T.G. Harbison 1041* (A); Augusta, *S.T. Olney and J. Metcalfe s.n.* (HUH); Augusta,

S.T. Olney and J. Metcalfe 29 (NCSC); Augusta sandhills, 08 Jul 1900, *A. Cuthbert 3* (NCU); Augusta, 14 Aug 1902, *A. Cuthbert s.n.* (2*FLAS); Augusta, 09 Apr 1919, *T.G. Harbison s.n.* (HUH). **Tatnall Co.:** (1) NE of Altamaha river, 12 Jul 1966, *J.R. Bozeman 5967* (NCU). **Wilkinson Co.:** (1) 5.3 km S of Baldwin Co.line on US Rte. 441, 01 Jun 1973, *D.E. Boufford and H.E. Ahles 9693* (HUH). **NORTH CAROLINA. Brunswick Co.:** (1) N of Southport, Pineland, 24 Apr 1935, *A.C. Matthews s.n.* (DUKE). **Cumberland Co.:** (1) near Stedman, *T.G. Harbison s.n.* (NCU). **New Hanover Co.:** (3) Carolina Beach, 14 May 1937, *Mills and Shrink s.n.* (NCSC); Mill Pond, Wilmington, 28 Jun 1905, *J.M. Macfarlane and O. Goenz s.n.* (DUKE); Cape Fear Peninsula, 28 Jul 1949, *W.B. Fox 2820* (NCSC). **Sampson Co.:** (1) near Stedman across the river, 28 Apr 1933, *T.G. Harbison and J.R. Totten s.n.* (NCU). **?? Co.:** (1) Western North Carolina, 23 May 1901, *W.W. Ashe 1949* (CM). **SOUTH CAROLINA. Aiken Co.:** (1) US 278 about 2 km E of jct. with bush 3 m tall, 29 Apr 1992, *J.B. Phipps 6573* (UWO). **Chesterfield Co.:** (1) Haw Ridge near McBee, 17 Jun 1933, *T.G. Harbison and H.R. Totten s.n.* (NCU). **Kershaw Co.:** (6) Camden, 12 May 1902, *T.G. Harbison 6124* (HUH); Hartsville, 07 Apr 1935, *BE Smith 219* (USCH); no locality, 18 May 1934, *E.J. Palmer 42393* (SC); near Camden, 19 Apr 1932, *E.J. Palmer 39953* (HUH); 4 mi W of Bethune, 07 Sep 1939, *R.K. Godfrey 8021* (GH, NY). **Lancaster Co.:** (1) 0.4 mi NE of little Lynches Creek, 06 Jun 1957, *J.G. Haesloop 27422* (NCU). **Newberry Co.:** (2) Billy Dreher Island, 18 Aug 1971, *L.H. Buff 410* (FLAS, USCH). **Oconee Co.:** (2) 4 mi NW of Walhalla, 04 May 1956, *H.E. Ahles and Bell 13923* (NCU); no locality, 30 Apr 1926, *T.G. Harbison 8008* (HUH). **Richland Co.:** (1) Between 6th Division Rd. and Wildcat Rd, 27 May 1992, *J.B. Nelson and B.S. Long 12594* (USCH). **Sumter Co.:** (1) no locality, 13 Jun 1993, *J.B. Nelson 14225* (USCH). **VIRGINIA. Chesterfield Co.:** (1) Cambridge, 5 Aug 1845, *R. Gray s.n.* (GH).

Crataegus lancei J.B. Phipps
ALABAMA. Barbour Co.: (1) Eufaula NWR, 15 Oct 1993, ***D. Drennan 95*** (UWO). **Clayton Co.:** (1) no locality, 20 Oct 1930, ***E.J. Palmer 5658*** (A). **Greene Co.:** (1) Smith Lake area, 14 Apr 1969, ***J. Thomas 1975*** (NCU). **FLORIDA. Alachua Co.:** (1) W of Gainesville, 20 Aug 1940, ***W.A. Murrill s.n.*** (GA). **Clay Co.:** (1) Hibernia, Mar 1869, ***W.M. Canby 1278*** (CM). **GEORGIA. Burke Co.:** (1) River Road, 18 km N of US 301, 12 Aug 1993, ***J.B. Phipps 6692*** (UWO). **Dougherty Co.:** (1) Albany, 18–19 Sep 1909, ***W.W. Eggleston 5118*** (MO). **Habersham Co.:** (2) Tallulah and Taccoa Falls, 8 Aug 1893, ***J.K. Small s.n.*** (GH, NY). **Richmond Co.:** (1) Augusta, sand bar ferry, no date, ***A. Cuthbert s.n.*** (FLAS). **NORTH CAROLINA. Brunswick Co.:** (1) Southport, 24 Apr 1935, ***A.C. Matthews s.n.*** (NCU). **Buncombe Co.:** (2) NW of Weaverville, 3 May 1999, ***R. Lance s.n.*** (UWO); New Stock Road and Alpine Meadows, 21 Oct 1998, ***R. Lance 98-51*** (UWO). **Mecklenburg Co.:** (1) Charlotte, no date, ***W.W. Ashe s.n.*** (NCU). **Moore Co.:** (1) Drowning Oak, 8 May 1975, ***J.F. Matthews, E. Edwards & T.P. Huntley s.n.*** (NCU). **Macon Co.:** (1) Franklin, 27 Apr no year, ***T.G. Harbison 520*** (A). **SOUTH CAROLINA. Chesterfield Co.:** (1) Haw Ridge, 22 Sep 1933, ***T.G. Harbison s.n.*** (NCU). **Kershaw Co.:** (1) SE side of US 1, 8 km S of Bethune, 11 Aug 1993, ***J.B. Phipps 6672*** (UWO). **Oconee Co.:** (1) Walhalla, 30 Apr 1926, ***T.G. Harbison 16481*** (NCU). **Richland Co.:** (1) near Ft. Jackson, 20 Jun 1958, ***J.A. Duke 1342*** (NCU).

Crataegus lassa Beadle
ALABAMA. Barbour Co.: (6) Eufaula NWR, 6 Apr 1993, *D.J. Drennan 81* (UWO); Eufaula NWR, 15 Apr 1992, *D.J. Drennan 00042* (UWO); Eufaula NWR, 19 Aug 1993, *D.J. Drennan 89* (UWO); Eufaula NWR, 3 Aug 1992, *D.J. Drennan 00059* (UWO); Lake Point State Park, 2 Jun 1989, *D.J. Drennan 00018* (UWO); Eufaula NWR, 15 Apr 1992, *D.J. Drennan 00053* (UWO). **Dallas Co.:** (18) Selma, no date, *T.G. Harbison s.n.* (NCU); near Selma, 19 Apr 1920, *T.G. Harbison s.n.* (NCU); Selma, 15 Apr 1970, *R. Kral 38586* (IBE, FSU, WILLI); Selma, 11 Apr 1912, *T.G. Harbison 10836* (2*NCU); Selma, 11 Apr 1913, *T.G. Harbison 836* (A); Selma, 19 Apr 1915, *T.G. Harbison s.n.* (A); Selma, 12 Apr 1912, *T.G. Harbison 843* (A); Selma, 9 Apr 1920, *T.G. Harbison 15728* (NCU); E side of 80 outskirts of Selma, 6 Apr 1984, *J.B. Phipps and T.C. Wells 5324* (2*UWO); E side of 80 outskirts of Selma, 6 Apr 1984, *J.B. Phipps 5326* (UWO); E side of 80 outskirts of Selma, 6 Apr 1984, *J.B. Phipps 5327* (UWO); E side of 80 outskirts of Selma, 6 Apr 1984, *J.B. Phipps 5329* (UWO); Outskirts of Selma, jct. US3O & AL 41, 7 Apr 1991, *J.B. Phipps 6471* (UWO); Rte. 140 8–10 mi E of Selma, 10 Apr 1998, *J.B. Phipps 7684* (UWO). **Macon Co.:** (3) no locality, 18 Jul 1967, *James Wright s.n.* (AUA); Tuskegee National Forest, 11 Apr 1976, *A.H. Sessler 016* (AUA, UWO). **Pike Co.:** (1) 5 mi SE of Troy, 28 Jun 1970, *R. Kral 39798* (UWO). **Russell Co.:** (1) Rte. 431 SW of Phoenix City 2.9 km SW of Russell Co. Rd 41, 8 Apr 1991, *J.B. Phipps 6479* (UWO). **FLORIDA. Alachua Co.:** (2) March, *A.H. Curtiss 811* (GA); Paynes Prairie Nature Reserve, Chacala Trail, 17 Aug 1993, *J.B. Phipps 6760* (UWO). **Citrus Co.:** (2) Citrus Springs, NW corner Athens Dr. and Sherman Dr.,15 Aug 1993, *J.B. Phipps 6745* (UWO); E side of US 41, 3 mi N of Hernando, 15 Aug 1993, *J.B. Phipps 6746* (UWO). **Gadsden Co.:** (3) Aspalaga, 5 Apr 1964, *Sidney McDaniel 4101* (IBE, FSU); 3 mi S of River Junction, 6 Aug 1927, *W.E. Manning and K.M. Wiegand 1353* (GH). **Leon Co.:** (2) Tallahassee, Sep 1901, *Biltmore Herb. 4947* (A); Tallahassee, Apr 1901, *Biltmore Herb. 4051* (A). **GEORGIA. Burke Co.:** (1) River Rd. A, 18 km N of US 301, 19 Apr 1992, *J.B. Phipps 6567* (UWO). **Columbia Co.:** (3) US 278, 4.5 km N Camp Gordon, 13 Aug 1993, *J.B. Phipps 6702* (UWO); US 278, 4.5 km N Camp Gordon, 13 Aug 1993, *J.B. Phipps 6703* (UWO); US 278, 4.5 km N Camp Gordon, 13 Aug 1993, *J.B. Phipps 6704* (UWO). **Randolph Co.:** (1) Cuthbert, 29 Mar 1918, *T.G. Harbison s.n.* (A). **Richmond Co.:** (5) Augusta, 16 Apr 1923, *T.G. Harbison 7005* (2*A); Augusta, Jul, *A. Cuthbert 107* (FLAS); Augusta, 9 Apr 1919, *T.G. Harbison 48* (A); Spur 56 5 km in, 18 Apr 1992, *J.B. Phipps 6558* (UWO). **Talbot Co.:** (5) Rte. 96 2 km E of Geneva, 9 Apr 1991, *J.B. Phipps 6484* (UWO); Rte. 96 2 km E of Geneva, 9 Apr 1991, *J.B. Phipps 6486* (UWO); Rte. 96 1 mi E of Junction City, 9 Apr 1991, *J.B. Phipps 6494* (UWO); Rte. 96 2 km E of Geneva, 9 Apr 1991, *J.B. Phipps 6481* (2*UWO). **Taylor Co.:** (1) 3 mi S of Junction City, 15 Apr 1978, *Mary P. Grant 078* (AUA). **SOUTH CAROLINA. Aiken Co.:** (1) Hwy. 4, 7 km E of junction w. Rte. 394, 16 Apr 1991, *J.B. Phipps 6513* (UWO). **Calhoun Co.:** (2) 4.3 mi ENE of St. Mathews, 14 Apr 1968, *S.W. Leonard 1264* (NCU, TC). **Lexington Co.:** (2) US 178, 4 km E of jct. SC113, 20 Apr 1992, *J.B. Phipps 6579* (UWO); Rte. 302 Clay Hill, 10 Apr 1991, *J.B. Phipps 6503* (UWO).

Crataegus lepida Beadle

FLORIDA. Alachua Co.: (1) 1 mi W of Fla. ??, 04 Apr 1981, *K.E. Woeste 3* (WILLI). **Citrus Co.:** (1) About 1.5 mi W of US 98, Aug 1995, *S. Riefler s.n.* (UWO). **Clay Co.:** (1) Middleburg, 26 Jun 1940, *W.A. Murrill and Bratley s.n.* (FLAS). **Highlands Co.:** (16) 4 mi N Lake Placid, 28 Feb 1961, *E.J. Palmer 10400* (USF); 3 mi N Lake Placid, 25 Apr 1960, *H.A. Gleason and R.J. Eaton 9757* (2*USF); 4 mi N Lake Placid, 07 Oct 1960, *J.D.Ray, O. Lakela and J. Patman 10400* (FLAS, FSU, USF); E of Sebring 2.8 mi from jct. with 17 at Sebring, 11 Sep 1987, *J.D. Skean and W.S. Judd and P. Alcorn 2132* (UWO); Sebring, 23 Apr 1964, *L.J. Brass 33210* (FLAS); US 17 jct. N of RR near jct. of Lake Letta Rd, 9 May 1982, *J. Eckner 2574* (USF); N of Lake Placid, 29 Sep 1079, *W.S. Judd with D.B. Ward and B. Judd 2504* (FLAS, FSU); Lakemont, 5 Sep 1981, *R.P. Wunderlin and J. Beckner 9127* (USF); Josephine Creek, 5 Oct 1960, *L.J. Brass 15319* (FLAS); Avon Park, 10 Apr 1948, *R. Garrett 171* (FLAS); S of Polk Co. Line, 3 Jun 1961, *O. Lakela 24226* (USF); Sebring, 5 Sep 1934, *J.K. Small and E. West s.n.* (FLAS). **Hillsborough Co.:** (2) 1.4 mi SE of centre of Sebring, 09 Mar 1993, *J.B. Phipps 6631* (UWO); 1.4 mi SE of centre of Sebring, 15 Aug 1993, *J.B. Phipps 6749* (UWO). **Osceola Co.:** (4) 5 mi NW of Loughman, 14 Oct 1960, *J.D. Ray, O. Lakela and J. Putman 10456* (FLAS, 2*USF); Kissimmee, 9 Apr 1938, *M.L. Singletory s.n.* (DUKE). **Polk Co.:** (4) At Greenlefe Resort, 21 Jun 1979, *D. Richardson and B. Hansen 5752* (USF); 3 mi E of Lake Hamilton, 10 Aug 1963, *H.S. Conard s.n.* (FLAS); Vicinity of Great Masterpiece Lake, Wales, 28 Jul 1962, *O. Lakela 25203* (USF); Marion Creek, 9 Sep 1931, *J.B. McFarlane 6643* (USF).**GEORGIA. Liberty Co.:** (2) 4 mi SW of Hinesville, 22 Jul 1927, *K.M. Wiegand and W.E. Manning 1348* (GH); 10 mi N of Hinesville, 18 Apr 1954, *W. Duncan 17804* (GA). **Pierce Co.:** (1) Blackshear, 28 Jun 1901, *A.H. Curtiss 6824* (DOV). **Screven Co.:** (2) Rte. 24, 12 mi S of US 301, 12 Aug 1993, *J.B. Phipps 6691* (UWO); Rte. 24, 12 mi S of US 301, 12 Aug 1993, *J.B. Phipps 6692* (UWO). **Tatnall Co.:** (1) no locality, 12 Jul 1966, *J.R. Bozeman 6001* (NCU). **?? Co.:** (1) no locality, no date, *H Corey s.n.* (NY). **LOUISIANA. Richland Parish:** (1) S of start of woods E of cemetery and LA 133 and N of I-20 Sec 4 and 9, 11 Apr 1978, *R.D. Thomas and N. Dawson 57507 and 1087* (NCU). **SOUTH CAROLINA. Colleton Co.:** (1) 0.7 mi SE jct. Co. 172 and 28, 05 Sep 1956, *H.E. Ahles and C.R. Bell 17918* (NCU). **Lexington Co.:** (1) 4 mi W of Lexington, 09 Apr 1985, *J. Seto, E. Tuggle, R. Wayson and C. Smith-Aulback s.n.* (USCH).

Crataegus munda Beadle

ALABAMA. Baldwin Co.: (5) Gateswood, 02 May 1903, *S.M. Tracy 8698* (GH, MSC, NCU, 2*US). **Conecuh Co.:** (1) S of Evergreen, 15 Oct 1923, *W.W. Ashe s.n.* (NCC). **Covington Co.:** (1) 19 mi N of Florala on US 331, 27 Apr 1969, *R. Kral 34546* (GA). **Cullman Co.:** (1) St. Bernard, 11 May 1934, *W. Wolf s.n.* (NO). **De Kalb Co.:** (1) E side of Rock Creek about ½ mi from mouth, 25 Sep 1948, *R.M. Harper 4096* (ALU). **Escambia Co.:** (1) Co. Rd 18 0.5 mi N of jct. with US 31-29, 07 Apr 1967, *R.L. Clark 10017* (NCU). **Etowah Co.:** (2) Gadsdale, 29 Jul 1900, *W.R. Maxon and C.L. Pollard 345* (A, GA). **Troy Co.:** (1) no locality, 2 Jul 1880, *C. Mohr s.n.* (ALU). **?? Co.:** (1) St. Bernard, 01 May 1910, *W. Wolf s.n.* (ALU). **FLORIDA. Alachua Co.:** (3) near Gainesville, 06 May 1940, *W.A. Murrill s.n.* (GA); no locality, 15 Apr 1930, *Loucks and West s.n.* (FLAS); E side of Gainesville, 11 Feb 1937, *West and Arnold s.n.* (FLAS). **Brevard Co.:** (1) Rockledge, 14 May 1897, *J. Crawford s.n.* (DUKE). **Citrus Co.:** (2) Crystal River, 24 Jun 1941, *L.E. Arnold and E. West s.n.* (FLAS); Orlando, S Riefler Nursery, 28 Apr 1996, *S. Riefler s.n.* (UWO). **Columbia Co.:** (1) Lake City, 01 May 1893, *Layne s.n.* (FLAS). **Escambia Co.:** (2) 5 mi W of Century, 08 Aug 1954, *E.S. Ford 42576* (FLAS); 3.5 mi W of Barnett Crossroads and 1 mi W of Big Escambia Creek, 08 Jul 1981, *G. Wilhelm 9212* (USF). **Gadsden Co.:** (2) Aspalaga, Apr no year, *300c* (GH, US). **Highlands Co.:** (1) N of Lake Placid near jct. of US Rte. 27 and Josephine Creek, 29 Sep 1979, *B. Judd, D.B. Ward and WS Judd 2504* (UWO). **Jackson Co.:** (2) 1.6 mi N of Marianna, 28 May 1973, *D. Boufford and H.E. Ahles 77051* (LSU); 1.5 mi N of Marianna, 27 May 1973, *D. Boufford and H.E. Ahles 9511* (A). **Leon Co.:** (1) Tallahasse, Apr 1843, *M. Rugel s.n.* (NY). **Liberty Co.:** (2) By FL Rte. 12, jct. with FL Rte. 171, N of Bristol, 22 Mar 1982, *R.K. Godfrey 79444* (FSU); 11 Apr 1957, *L.J. Uttal 5382* (LYN). **Marion Co.:** (1) 3 mi S of Ocala, 11 Aug 1939, *W.A. Murrill s.n.* (FLAS). **Okaloosa Co.:** (1) E of Rock Creek near Hurricane lake, 16 Jun 1980, *G. Wilhelm 7534* (USF). **Suwanee Co.:** (1) Hildreth, 21 Aug 1940, *W.A. Murrill s.n.* (A). **Volusia Co.:** (1) no locality, 01 Aug 1900, *A.H. Curtiss 6703* (NCU). **GEORGIA. Barrow Co.:** (1) 1.2 mi W of Windsor, 25 Jun 1941, *W.H. Duncan 3564a* (GA). **Berrien Co.:** (1) Nashville, between Marion St and GA 125, 19 Apr 1981, *G.F. Joye 423* (LSU). **Burke Co.:** (2) Rte. 56 S of McBean, 13 Aug 1993, *J.B. Phipps 6710a* (UWO); N of intersection with 80, 09 Apr 1991, *J.B. Phipps 6496* (UWO). **Candler Co.:** (2) 0.1 mi W of Lotts Creek and 0.1 mi N of road that crosses creek, 22 Apr 1975, *D.J. Drapalik and W.W. Walker 69* (NCU); 11 mi WNW of Statesboro and NW of Upper Lotts Creek Church, 11 Apr 1977, *D.J.Drapalik and C. Thomas 39* (NCU). **Charlton Co.:** (1) near Folkston, 23 Mar 1940, *J.H. Miller 20* (GA). **Clarke Co.:** (1) Along Oconee River, SE edge of university campus, 16 Apr 1955, *M. Duncan s.n.* (GA). **Liberty Co.:** (1) 11 mi E of Taylor Creek, 27 Apr 1940, *W.H. Duncan 2236* (GA).**Rabun Co.:** (2) Canyon at Tallulah Falls, 16 Aug 1893, *J.K. Small s.n.* (GH); Tallulah River Creek, Sep 1999, *R. Lance s.n.* (UWO). **Richmond Co.:** (10) near Augusta, 23 Apr 1900, *C.S. Sargent s.n.* (DOV); Augusta, 11 Apr 1916, *W.W. Ashe s.n.* (NCU); Augusta, 27 Apr 1902, *A. Cuthbert s.n.* (FLAS); US 1, 10 mi E of Briar Creek, 16 May 1958, *J.A. Duke 665* (NCU); US 1, E of Bath Rd, 14 Aug 1958, *J.A. Duke 2051* (NCU); 2.9 mi E of jct. US 1 and 88, 19 Jul 1958, *J.A. Duke 1636* (NCU); Augusta, no date, *S.T. Olney and J. Metcalf 221* (GH); Augusta, no date, *S.T. Olney and J. Metcalf 220* (NCSC); Augusta sandhills, 27 Apr 1902, *A. Cuthbert s.n.* (FLAS); Augusta, 9 Aug 1902, *A. Cuthbert s.n.* (FLAS). **Screven Co.:** (2) 3.5 mi N jct. GA 17 on 301, 11 Jun 1961, *H.E. Ahles 54343* (NCU); 17.6 km NE of Newington, 18 Apr 1992, *J.B. Phipps 6561* (UWO). **Taylor Co.:** (1) 3 mi E of Rupert, 12 mi S of Butler, 02 May 1942, *W.H. Duncan 5101* (GA). **Talbot Co.:** (2) 2 km ENE of Geneva, 09 Apr 1991, *J.B. Phipps 6587* (UWO); 2 km ENE of Geneva, 13 Aug 1993, *J.B. Phipps 6729* (UWO). **Thomas Co.:** (1) Along roadside US 19 2 mi N of Thomasville, 26 Apr 1952, *S.C. Hood 4511* (FLAS). **Turner Co.:** (2) Along US 75 4.5 mi NE of Ashburn, 03 Jun 1964, *W.R. Faircloth 1054* (GA, NCU). **Walton Co.:** (1) S side of Ga 138, 35 mi W of Athens, 22 Apr 1981, *G.F. Joye 545* (LSU). **Washington Co.:** (1) no locality, 30 Apr 1942, *W.H. Duncan 4937* (GA). **MISSISSIPPI. Forrest Co.:** (3) E of Pep's

Point, 14 Sep 1969, *K.E. Rogers 1404-A* (GH, UWO); Just E of Pep's Point, 14 Sep 1969, *K.E. Rogers 1404-B* (NCC). **Jones Co.:** (1) 5.5 mi SW of Ellisville, 12 Jun 1960, *J.G. Teer 190* (IBE). **NORTH CAROLINA. Cumberland Co.:** (2) 2.3 mi SW of Hope Mills, 11 Oct 1957, *H.E. Ahles 36604* (NCU); On Rte. 87 near jct. with NC 210, 07 Aug 1948, *E.T. Browne Jr. 294* (KY). **Durham Co.:** (1) Duke Forest, 08 Apr 1951, *W.T. Batson 751* (NCU). **Fayetteville Co.:** (2) no locality, 21 Apr 1909, *W.W. Eggleston 4929* (CM); no locality, 26 Aug 1908, *W.W. Eggleston 4013* (MSC). **Franklin Co.:** (1) near Rte. 56 about 5 mi W of Castalia, 26 Apr 1963, *R.J. Wilbur 6793* (DUKE). **Harnett Co.:** (3) 3 mi SW of Spout Springs, 11 Jul 1968, *S.W. Leonard, A Burnham and M Ripperton 1745* (LAF, NCC, USCH). **Hoke Co.:** (1) 0.4 mi SW of Ashley Heights, 11 May 1957, *M. Neuber and H.E. Ahles 24974* (NCU). **Lenoir Co.:** (1) Few mi S of La Grange, 16 Apr 1991, *J.B. Phipps 6510* (UWO). **McDowell Co.:** (1) 5.5 mi WSW of Dysortville, 1.6 mi ENE of US 221, 01 Sep 1956, *H.E. Ahles and C.R. Bell 17794* (NCC). **Moore Co.:** (3) 4 mi SW of Pinebluff, 01 Jul 1927, *W.E. Manning and K.M. Weigand 1344* (GH); no locality, 20 Jul 1930, *11941* (DUKE); Wildlife Club, SR 1004 at Drowning Creek, 06 May 1976, *T.P. Huntley and J.F. Matthews s.n.* (NCU). **Richmond Co.:** (1) 4 mi E of Hamlet, 1 Jul no year, *K.M. Wiegand and W.E. Manning 1345* (G). **Rowan Co.:** (1) Vicinity of Faith Post Office, 14 Aug 1981, *J.K. Small and AA Heller s.n.* (MSC). **Rutherford Co.:** (1) Midway between Rutherford and Chimney Rock, 08 Aug 1932, *W.C. Coker s.n.* (NCC). **Scotland Co.:** (2) 7 mi S of Laurinburg on No 501, 05 Mar 1937, *M.L. Loker 2* (NCU); Juniper Creek 1.3 mi NE of Silver Hill, 08 May 1957, *H.E. Ahles 24779-A* (NCU). **SOUTH CAROLINA. Anderson Co.:** (3) no locality, 19 Apr 1912, *J. Davis 7757* (US); Private yard, 19 Apr 1912, *J. Davis 7701* (GH, US). **Berkeley Co.:** (1) 1.8 mi E of jct. SC Rte. 45 and Rte. 6 on SC Rte. 6, 07 Apr 1957, *J.G. Haesloop and H.E. Ahles 22403* (NCU). **Chesterfield Co.:** (1) Little Black Creek near SC 265, 05 Jun 1956, *A.E. Radford 12371* (NCU). **Darlington Co.:** (3) Co. Rte. 360 E of Co. Rte. 1040, 2 mi W of downtown Hartsville, 13 May 1988, *C. Horn and D. Rayner 2610* (USCH); N of Lauther's Lake, 03 Aug 1941, *B.E. Smith 952* (USCH); Hartsville, 03 Aug 1940, *B.E. Smith 952* (NCC). **Kershaw Co.:** (2) near US 601, 1.5 mi N of Camden, 04 Jun 1957, *A.E. Radford 23733* (FSU, NCU). **Lancaster Co.:** (2) near Kershaw, 26 Jul 1906, *H.W. House 2605* (MO); 0.4 mi NNE of Little Lynches Creek on US 601 and 1 mi E on dirt road, 06 Jun 1957, *J.G. Haesloop and H.E. Ahles 27425* (NCC). **Lexington Co.:** (1) 0.4 mi W of S. Lake Drive, 21 Sep 1987, *S.R. Hill 18843* (USCH). **Oconee Co.:** (1) no locality, 18 Oct 1915, *W.W. Ashe s.n.* (NCU). **Orangeburg Co.:** (1) 4.7 mi WNW jct. US 301-601 and SC 4 on SC 4, W of Orangeburg, 18 May 1957, *J.G. Haesloop and H.E. Ahles 25272* (NCU). **Richland Co.:** (1) Headwaters of Cobb's Pond within St. Lo Range Training Area 12, 01 Jun 1992, *B. Long and J.G. Nelson 681* (USCH).

Crataegus pexa Beadle
GEORGIA. Bryan Co.: (1) 1.9 mi NE of Pembroke, 30 Aug 1961, *J.A. Boole Jr. 1215* (NCU). **Richmond Co.:** (1) Augusta, 25 Apr 1900, *A. Cuthbert 11* (DOV). **Tatnall Co.:** (1) 3.7 mi SW of Glennville, 24 Aug 1965, *M.G. Padgett 9* (GA). **NORTH CAROLINA. Craven Co.:** (1) New Bern, 20 Apr 1919, *T.G. Harbison s.n.* (A). **Cumberland Co.:** (2) 1.4 mi SW of Fayetteville, 27 Jun 1957, *J. Haesloop and H.E. Ahles 29718* (NCU); 2 mi E of Stedman, Sep 1931, *H.R. Totten s.n.* (NCU). **Harnett Co.:** (7) Pineview, 3 Jun 1957, *H. Laing 1542* (NCU); 0.1 mi W of Johnsonville, 8 May 1957, *H. Laing 1211* (2*NCU); Spout Springs, 18 Apr 1929, *B.W. Wells s.n.* (NCSC); 0.1 mi S of Coates, 15 May 1957, *H. Laing 1315* (NCU); 1.4 mi W of Angier, 24 Apr 1957, *H. Laing 1035* (NCU); 18 mi S of Sanford, 21 Jun 1958, *J.A. Duke 1145* (NCU). **Jackson Co.:** (1) Cherokee, 20 August 1891, *H.C. Beardslee and C.A. Kofoid s.n.* (GH). **Johnson Co.:** (2) 2 mi S of Smithfield, 3 May 1940, *Radford and Stewart s.n.* (GA); 2 mi SE of Four Oaks, 29 Jul 1970, *R.M. Downs and E. Upchurch 11424* (NCSC). **Lenoir Co.:** (1) 1.5 mi W of Jenny Lind, 11 Oct 1958, *C.J. Burk s.n.* (NCU). **Montgomery Co.:** (1) NE corner of Co., 31 May 1953, *Lionel Melvin s.n.* (NCU). **Moore Co.:** (5) 5 mi E of Carthage, 12 May 1958, *J.A. Duke 506* (NCU); E of Harnett Co. line, 25 Apr 1948, *R.J. Campana and R.K. Godfrey s.n.* (NCSC); Southern Pines, 19 Jul 1895, *J.W. Blankinship s.n.* (GH); Southern Pines, 19 Jul 1895, *J.W. Blankinship s.n.* (GH); 0.7 mi N junction US 1 and US 15, 19 Jul 1958, *J.A. Duke 1367* (NCU). **New Hanover Co.:** (2) Wilmington, 15 Apr 1911, *C.S. Williamson s.n.* (CM); Wilmington, 1867, *W.M. Canby s.n.* (NY). **Rowan Co.:** (1) 2 mi NE of Spencer, 26 May 1956, *A.E. Radford and H.E. Ahles 12900* (NCU). **Sampson Co.:** (2) 1.2 mi N of Salemburg, 22 Apr 1957, *R.L. Wilbur 5221* (DUKE, FSU). **Wayne Co.:** (2) 5.6 mi NW of Seven Springs, 21 Jun 1957, *A.E. Radford 25539* (NCU); 0.2 mi N of Neuse Road on N.C. Route 111, 22 Sep 1950, *W.B. Fox with S.O. Boyce and R.K. Godfrey 4312* (NCSC). **Wilson Co.:** (1) 1 mi NW of Sims, 28 Jul 1958, *A.E. Radford 37992* (NCU). **SOUTH CAROLINA. Kershaw Co.:** (1) 4 mi W of Bethune, 7 Sep 1939, *R.K. Godfrey 8021* (MO). **Spartanburg Co.:** (1)near Campobello, 20 Jun 1942, *E.M. Walker 3489* (NCU).

Crataegus quaesita Beadle
FLORIDA. Alachua Co.: (3) Gainesville, 29 Mar 1940, *W.A. Murrill s.n.* (A); Gainesville, 17 Mar 1941, *W.A. Murrill s.n.* (A); Gainesville, 19 Jul 1979, *K.D. Perkins & B.J. Judd 657* (FLAS). **Clay Co.:** (11) Magnolia Springs, 9 Apr 1920, *T.G. Harbison 5667* (A); Magnolia Springs, 9 Apr 1920, *T.G. Harbison 5679* (A, NCU); Magnolia Springs, 9 Apr 1920, *T.G. Harbison 5670* (A); Magnolia Springs, 9 Apr 1920, *T.G. Harbison 5666* (A); Magnolia Springs, 9 Apr 1920, *T.G. Harbison 5676* (A); Magnolia Springs, 7 Apr 1920, *T.G. Harbison 5665* (A); Magnolia Springs, 9 Apr 1920, *T.G. Harbison 5670* (A); Magnolia Springs, 21 Mar 1981, *G. Martin s.n.* (MO); Hibernia, Mar 1869, *W.M. Canby s.n.* (GH, NY). **Columbia Co.:** (1) Lake City, 1 Apr 1920, *T.G. Harbison 5661* (A). **Duval Co.:** (6) Jacksonville, 25 Mar 1901, *A.H. Curtiss s.n.* (GH); Jacksonville, Mar no year, *A.H. Curtiss s.n.* (NCU); Jacksonville, in fruit, no date, *A.H. Curtiss s.n.* (NCU); Jacksonville, 1 Aug 1894, *A.H. Curtiss 4552* (GA); Jacksonville, 7 Apr 1885, *C.E. Faxon s.n.* (NY); Jacksonville, 8 Apr 1885, *C.E. Faxon 1858* (A). **Gadsden Co.:** (1) Betw. Chattahoochee and Mt. Pleasant, 14 Mar 1937, *1937 Exploration Party* (FLAS). **Lafayette Co.:** (1) 4 mi W of Mayo, 6 Sep 1940, *W.A. Murrill & W.B. Tisdale s.n.* (FLAS). **Lake Co.:** (1) Ocklawanna R. and Umatilla, 13 Jun 1940, *Watson & W.A. Murrill s.n.* (FLAS). **Leon Co.:** (3) W of Tallahassee, 17 Mar 1982, *R.K. Godfrey & D.W. Hall 79429* (FLAS); Tallahasee, 9 Mar 1914, *C.S. Sargent s.n.* (A); 5 mi W of Tallahasee, 11 Apr 1931, *E. J.Palmer 38517* (A). **Liberty Co.:** (2) Bristol, 6 Sep 1940, *W.A. Murrill & W.B. Tisdale s.n.* (FLAS); Torreya State Park, 19 Jul 1938, *W.P. Porter s.n.* (FLAS). **Madison Co.:** (1) Ellaville, 21

Aug 1940, *W.A. Murrill & W.B. Tisdale s.n.* (FLAS). **Marion Co.:** (6) Ocala, 14 Apr 1940, *W.A. Murrill & Watson s.n.* (FLAS); Ellavale, 21 Aug 1940, *W.A. Murrill & W.B. Tisdale s.n.* (FLAS); near Ocala, 11 Aug 1939, *W.A. Murrill s.n.* (FLAS); Rainbow Springs, 11 Aug 1940, *W.A. Murrill s.n.* (FLAS); 9 mi W of Weirsdale, 22 Mar 1970, *L. Baltzell 1750* (FLAS); Ocala, 8 Mar 1883, *J.D. Smith s.n.* (GH). **Suwannee Co.:** (3) 1 mi E of Ellaville, 31 Mar 1957, *R. Kral 4363* (NCSC); 1 mi E of State Park, 31 Mar 1982, *H.B. & D.S. Correll 53520* (NY); Hildreth, 11 Jul 1940, *W.A. Murrill s.n.* (FLAS). **GEORGIA. Bulloch Co.:** (2) 4 mi SW of Statesboro, 27 Mar 1962, *G.P. DeWolf 1722* (GA, NCU). **Floyd Co.:** (1) Rome, 25 Apr 1901, *Biltmore Herb. 4194* (A). **Gwinnett Co.:** (1) Anniston, 6 Apr 1900, *C.S. Sargent s.n.* (A). **Lowndes Co.:** (1) no location, 27 Mar 1980, *K.D. Perkins & B.J. Judd 126* (FLAS). **Randolph Co.:** (1) 3 mi NW of Cuthbert, 12 Apr 1913, *T.G. Harbison 1364* (A). **Tattnall Co.:** (1) 1.9 mi NW of Reidsville, 11Jun 1961, *H.E. Ahles 54272* (NCU). **Taylor Co.:** (1) 1 mi W of Howard, 22 Mar 1938, *J.H. Pyron & R. McVaugh 2287* (GA). **Washington Co.:** (2) E of Cowpen Creek, 12 Oct 1941, *W.H. Duncan 4331* (GA, NCSC). **Webster Co.:** (2) no location, 8 Oct 1939, *W.H. Duncan s.n.* (GA, NCU). **Wheeler Co.:** (1) along Little Ocmulgee River, 12 Apr 1942, *W.H. Duncan 4715* (GA).

Crataegus sp. aff. **resima**
FLORIDA. Duval Co.: (6) Jacksonville, Mar, *A.H. Curtiss 811* (GA, 2*GH, MO, 2*NY).

Crataegus vicana Beadle
ALABAMA. Barbour Co.: (1) Eufaula NWR, 6 Apr 1993, *D.Drennan 80* (UWO). **FLORIDA. Alachua Co.:** (4) Gainesville, 28 Jun 1940, *W.A. Murrill s.n.* (FLAS); near Micanopy, 6 Apr 1931, *E.J. Palmer 38412* (A); Gainesville, 7 Apr 1931, *E.J. Palmer 38424* (A); Rte. 24, SW of Kanapaha and 4 km SW of SR 127, 12 Mar 1993, *J.B. Phipps 6667* (UWO). **Baker Co.:** (3) near Glen Saint Mary, 1 Apr 1924, *H.H. Hume s.n.* (A); Lake City, 19 Mar 1892, *P.H. Rolfe s.n.* (FLAS, MO). **Clay Co.:** (1) Green Cove Springs, 10 Apr 1940, *W.A. Murrill s.n.* (FLAS). **Gadsden Co.:** (1) Chattahoochee, 9 Mar 1897, *collector?? 2723* (MO). **Highlands Co.:** (1) Highlands Hammock State Park, 5 Jul 1949, *R. Garrett s.n.* (FLAS). **Lafayette Co.:** (1) Old Town, 31 Mar 1919, *T.G. Harbison* 5627 (NCU). **Leon Co.:** (5) 4 mi W of Tallahassee, 7 Apr 1958, *R.K. Godfrey 56422* (AUA, DUKE, FSU, LAF, USF). **Levy Co.:** (1) near Chiefland, 7 Apr 1931, *E.J. Palmer 38436* (A). **Liberty Co.:** (5) Bristol, Mar 1890, *W.M. Canby s.n.* (DOV); Tallahassee, 4 Apr 1972, *P. Elliot 2* (FSU); Tallahassee, 6 Apr 1920, *T.G. Harbison 5644* (A); Tallahassee, 2 Apr 1920, *T.G. Harbison 5647* (A); 15 mi W of Tallahassee, 2 Apr 1959, *R.K.Godfrey 58290* (FSU). **Madison Co.:** (2) Ellaville, 21 Aug 1939, *W.A. Murrill s.n.* (FLAS); no locality, 31 Mar 1914, *T.G. Harbison 1434* (A). **Marion Co.:** (3) near Ocala, 6 Apr 1929, *E.J. Palmer 35185* (A); 4 mi W of Ocala, 20 Mar 1958, *G.R. Cooley & R.J. Eaton 5756* (FSU, USF). **Suwannee Co.:** (2) 1 mi E of State Park, 31 Mar 1982, *D.S. & H.B. Correll 53520* (USF); 5 mi S of Live Oak, 21 Auf 1939, *W.A. Murrill & W.B. Tisdale s.n.* (FLAS). **GEORGIA. Berrien Co.:** (1) 4.5 mi NE of Five Mile Creek, NE of Weber, 23 Jun 1966, *J.R. Bozeman 4838* (NCU). **Bibb Co.:** (1) 7 mi Se of Macon, 12 Apr 1940, *W. Duncan 1906* (GA). **Bryan Co.:** (1) E of Canoochee River, 14 Jul 1966, *J.R. Bozeman 6043* (NCU). **Decatur Co.:** (3) 0.75 mi W of Brinson, near Seminole Co. line, 31 Mar 1982, *R.K. Godfrey 79488* (FSU); 4 mi N of Mt. Pleasant Community, 31 Mar 1982, *R.K. Godfrey 79496* (FSU); Rte. 97 and railroad, 1 mi S of Faceville, 28 May 1983, *R.K. Godfrey 79488* (FSU). **Floyd Co.:** (1) Rome, 5 May 1899, *Wm. Canby 28* (DOV). **Lowndes Co.:** (2) E of I-75 on N side of GA 375, 27 Mar 1980, *W.S. Judd & K.D. Perkins 2596* (LAF); 5.3 mi S of Valdosta, 21 May 1970, *C. Scott 13* (MO).

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INDEX OF NAMES

Accepted taxa in roman; synonyms and species mentioned only in discussion in italics; a "?" indicates synonymy is uncertain; numbers represent ordinal sequence of species in text or page numbers.

Crataegus
- *?adunca* Beadle, 10
- *adusta* Beadle, 5
- alabamensis Beadle, 10
- *?amica* Beadle, 17
- *anisophylla* Beadle, 7
- *arguta* Beadle, 9
- attrita Beadle, 15a
- *?audens* Beadle, 9
- *cirrata* Beadle, 2
- *clara* Beadle, 9
- colonica Beadle, 12
- *compitalis* Beadle, 9
- condigna Beadle, 9
- *?constans* Beadle, 11
- crocea Beadle, 5
- *cuthbertii* Ashe, 1149
- *curva* Beadle, 5
- *?dapsilis* Beadle, 10
- dispar Beadle, 22
- *dolosa* Beadle, 11
- egens Beadle, 2
- exilis Beadle, 23
- *flava* Aiton, 1102
- *flava* var. *integra* Nash, 11
- florens Beadle, 14
- floridana Sargent, 15
- *frugalis* Beadle, 5
- *fruticosa* Sargent, 1104
- furtiva Beadle, 18
- *garrettii* Murrill, 1108
- *?geniculata* Ashe, 4
- *glandulosa* Michx., 1102
- " Moench, 1103
- " Georgi, 1103
- *illudens* Beadle, 16
- *?incana* Beadle, 5
- *?inopina* Beadle, 5a
- *?inops* Beadle, 17
- *insidiosa* Beadle, 9
- integra (Nash) Beadle, 11
- invicta Beadle, 8
- lacrimata Small, 3
- lanata Beadle, 17
- lancei J.B. Phipps, sp. nov., 20
- lassa Beadle, 16
- ?laxa Beadle, 6
- lepida Beadle, 1
- meridiana Beadle, 19
- *michauxii* Persoon, 1102
- munda Beadle, 4
- *panda* Beadle, 16
- *pearsonii* Ashe, 1149
- pexa Beadle, 13
- pulla Beadle, 15b
- quaesita Beadle, 6
- *?rava* Beadle, 9
- *ravenelii* Sargent, 9
- *recurva* Beadle, 5
- *resima* Beadle, 6
- *rimosa* Beadle, 9
- Robustae, subser. nov., 1124
- senta Beadle, 21
- *sodalis* Beadle, 11
- Tenues, subser. nov., 1108
- teres Beadle, 14
- *?versuta* Beadle, 7
- viaria Beadle, 6
- vicana Beadle, 5a
- *villaris* Beadle, 5
- *?yadkinensis* Ashe, 20

DICERANDRA MODESTA (LAMIACEAE): RAISE IN RANK FOR A DISJUNCT PERENNIAL IN A NEW COASTAL CLADE IN FLORIDA

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ABSTRACT

Dicerandra frutescens subsp. **modesta** is raised to species rank: *Dicerandra modesta*. Recent molecular studies show this new perennial species to be a disjunct aligned with the *Dicerandra* species of the Atlantic Coastal Ridge of eastern Florida not with *Dicerandra frutescens* of the Lake Wales Ridge of interior central Florida. Differences in corolla coloration, anther spur ornamentation and pollination ecology distinguish *Dicerandra modesta* from the members in the new coastal clade.

Key Words: *Dicerandra modesta*; Lake Wales Ridge; Atlantic Coastal Ridge; southeastern U.S. endemics; pollination

RESUMEN

Dicerandra frutescens subsp. **modesta** se eleva al rango de especie: *Dicerandra modesta*. Recientes estudios moleculares muestran que esta nueva especie perenne es disyunta y emparentada con las especies de *Dicerandra* de la cadena costera del este de Florida y no con *Dicerandra frutescens* de la cadena de Lake Wales de la parte interior central de Florida. Las diferencias en la coloración de la corola, la ornamentación del espolón de la antera y la ecología de la polinización diferencian *Dicerandra modesta* de los miembros del nuevo clado costero.

New molecular phylogenetic evidence (Oliveira et al. 2007) necessitates a review of the status of *Dicerandra frutescens* Shinners subsp. *modesta* Huck, and, when supported by distinctive morphological and pollination characters, requires a raise in rank to species so that this new taxon can be represented correctly in the upcoming volume of the Lamiaceae for the Flora of North America Project. This designation is in keeping with the concept of species within the group.

Dicerandra modesta (Huck) Huck, comb. et stat. nov. Basionym: *Dicerandra frutescens* Shinners subsp. *modesta* Huck, Novon 11:417. 2001. Type: U.S.A. Florida. Polk Co: Black Road, E of Dundee, sandy ridge, 30 m, 9 Sep 1999, *R.B. Huck 5555* (holotype: FLAS!; isotypes: MO!, USF!).

An endemic genus of the southeastern United States characterized by spurred anthers, *Dicerandra* has 4 annual species in *D.* subgenus *Dicerandra* and, now, 6 perennial species in *D.* subgenus *Kralia*, the latter all rare and found on relict, island-like sandy ridges in Florida (Huck 1987, 1992, 2001, 2007; Huck & Chambers 1997; Huck et al. 1989). With a pale yellow to pinkish-white corolla, a geniculate corolla tube and smooth spurred anthers typical of adaptations to bee fly pollination, *Dicerandra modesta* was originally recognized as a subspecies of *D. frutescens*, a taxon with a similar morphology and adaptation (Huck 1987, 2001; see Deyrup & Menges 1997). Further, this previous subspecies was thought to be yet another of the many endemics of the Lake Wales Ridge (Huck et al. 1989; Christman & Judd 1990), the interior ridge of central Florida. However, in the molecular phylogenetic study of Oliveira et al. (2007), both an analysis of ITS data and a combined analysis of ITS and chloroplast data sets showed *Dicerandra modesta* was surprisingly not allied with *D. frutescens*, but instead, was included in a well supported coastal clade with coastal species *D. thinicola* H.A. Mill. and *D. immaculata* Lakela. Another tree based on chloroplast data supported the distinctness of these perennial species (Oliveira et al. 2007). In contrast to *Dicerandra modesta*, these two coastal taxa have pale purple to purplish-red to pink corollas, smoothly bent corolla tubes and ornamented "brush" anthers spurs typical of bee pollinator adaptation.

Dicerandra thinicola and *D. immaculata* (and its variety *D. immaculata* var. *savannarum* Huck) grow in isolated sand pine [*Pinus clausa* (Chapm. ex Engelm.) Vasey ex Sarg.] – oak scrub (*Quercus geminata* Small;

J. Bot. Res. Inst. Texas 2(2): 1163 – 1164. 2008

Q. myrtifolia Willd.) plant communities near the ocean 60 miles from one another along the 300-mile-long Atlantic Coastal Ridge of Florida, some 60 to 80 miles to the east of the type locality of *D. modesta* found in a similar habitat on the parallel central ridge. Both *Dicerandra modesta* and *D. thinicola* are tetraploids and, at least based on ITS data, are more closely related to each other than to hexaploid *D. immaculata* (Huck & Chambers 1997; Oliveira et al. 2007).

Dicerandra modesta is a chamaephytic perennial with floral shoots arising from a branched woody base and the inflorescence is a verticillaster with 2–3 flowers to a cyme, blooming successively in an exuberant burst from late August through September. The specific name *modesta* meaning "shy" is derived from the tendency of the pale yellow-colored corollas to blush to pink when the flowers are in full anthesis. The very slender, geniculate tube of the corolla flares to a trumpet-shape, with the upper lobe an ovate-shaped standard, marked with trellised red-purplish markings and the lower tripartite lobe, separated from the upper lobe by a deep sinus, is marked with spots of the same color. Four stamens are declinate along the lower lobe of the corolla and the anthers have large pollen sacs divided by a glandular, widened connective. Each pollen sac is subtended by a linear, glabrous or a few-haired spur terminating in a forked tip of 3–5 cells. *Dicerandra modesta* is apparently reproductively isolated from the two coastal species by geography, pollinator preference and, in the case of *D. thinicola* (which blooms in October and November), a displacement of blooming time. A key to this small genus will be included in the treatment in the Flora of North America Project.

ACKNOWLEDGMENTS

I thank D.L. Black for observations on the pollination of *Dicerandra modesta*. I thank H.L. Chambers and an anonymous reviewer for their insightful comments and T. Lindler, and especially K. Perkins and N.H. Williams (FLAS) for their continuing generosity and support.

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TWO NEW NAMES IN THE CARIBBEAN FLORA

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The *Flora of Hispaniola* has been published from 1990 to 2000, describing the plants known at that time from the Island of Hispaniola. As happens for every Flora, many additions have been made to the existing knowledge of the plants in the Island; furthermore, quite a number of taxonomical changes have been made and need to be made known to the scientific community. I have been working on the project of revising the published volumes; these volumes include the Dicotyledons, less the Cactaceae, that have been left for the specialists in that family. In this process, I have found two illegitimate names, published by mistake, and these names have to be re-named.

Salvia toaensis Alain, nom. nov. *Salvia nigrescens* Alain, Contr. Ocas. Mus. De La Salle 15:12. 1956; non *Salvia nigrescens* Bull., Retail List 121: 170. 1876.

Hedyotis ekmanii Alain, nom. nov. *Hedyotis nigrescens* (Urb. & Ekm.) Alain, Phytologia 54:103. 1983; non *Hedyotis nigrescens* Merr., J. Arnold Arbor. 23:193. 1942.

ACKNOWLEDGMENTS

I thank Scott Zona for his comments on the paper.

BOOK REVIEW

James K. Agee. 2007. **Steward's Fork: A Sustainable Future for the Klamath Mountains.** (ISBN-10: 0520251253, ISBN-13: 978-0520251250, hbk.). University of California Press, 2120 Berkeley Way, Berkeley, California 94704-1012, U.S.A. (**Orders:** www.ucpress.edu, orders@cpfsinc.com, 800-777-4726). $42.00, 306 pp., black/white photographs, line illustrations, 7 maps, 6" × 9".

The Klamath Mountains, and more particularly the Trinity and Marble Mountains, of California are the area that Agee discusses with much love and insight. But his insights are of value to those living beyond these mountains as well. The discussions of the use of the natural resources, the continued use and care of the land, and the principles of how to responsibly manage those ecosystems can be applied anywhere in the world.

The first chapters in the text cover the geologic development of the area, the flora and fauna, and the native peoples. A story of Agee's efforts to retrace and best Alice Eastwood's collecting survey along Canyon Creek in 1901 is engaging and enlightening, particularly so when he reveals that even with a checklist in hand he was unable to surpass her count. The description of his attempt and of the collecting area enables one to learn the history and other information about the area during his telling. Other chapters cover the indigenous peoples and their impact on the ecosystem, mining, livestock grazing, and water issues. Final chapters cover his views on how we can provide proper stewardship for a sustainable future.

Agee is able to use his memories of time and place to make the present and future both real and attainable. He writes with considerable skill and is able to use his memories as both story and moral. Regarding choices he reveals that as a child riding inner tubes on the Stuart Fork he did not always take the best fork of the channel and as a consequence was dunked or flipped over. But he retrieved his tube and tried again. He had limited knowledge of what was downstream but adjusted his course along the way. We now have the same challenge in choosing a course for the Klamath Mountains and for the rest of our ecosystems.

Steward's Fork is well illustrated with excellent images and maps. Concluding the book are an index, appendices, and a remarkable bibliography. The bibliography is arranged by chapter and cites books, periodicals, and web sites. As one who first turns to the bibliography of any new book that lands in my hands to determine its possible value as a research tool, this book was impressive and is recommended for any library or for anyone interested in the area. It will appeal to general readers as well as professionals and specialists.—*Gary L. Jennings, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

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TROCHANTHERA LEPIDOTA GEN. AND SP. NOV., A FOSSIL ANGIOSPERM INFLORESCENCE IN DOMINICAN AMBER

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ABSTRACT

Trochanthera lepidota gen. & sp. nov., represented by a capitate male inflorescence at anthesis, is described from Tertiary Dominican amber. The genus is characterized by small, staminate flowers arising from between persistent flat-topped bracts on a spherical receptacle. Each flower is composed of 3–4 stamens, with distally connivent filaments and bilocular anthers showing longitudinal extrorse dehiscence. The perianth is represented by a short, appressed, truncate sheath around the filament column. The remaining fragment of stem below the head is leafless and minutely puberulent. The fossil, although of uncertain affinity, shows similarities to the families Balanophoraceae and Moraceae.

Key Words: amber, Balanophoraceae, Dominican Republic, fossil flower, Greater Antilles, Moraceae, Tertiary

RESUMEN

Trochanthera lepidota gen. & sp. nov., representada por una inflorescencia masculina capitada en antesis, es descrita del ámbar terciario dominicano. El género se caracteriza por tener flores estaminadas pequeñas que surgen de entre brácteas persistentes de ápice plano en un receptáculo esférico. Cada flor se compone de 3–4 estambres, con filamentos connniventes distalmente y anteras biloculares con dehiscencia longitudinal extrorsa. El perianto está representado por una vaina corta, truncada y apresada alrededor de la columna de filamentos. Es resto de fragmento de tallo debajo de la cabezuela no tiene hojas y es ligeramente puberulento. El fósil, aunque de afinidad incierta, muestra semejanzas con las familias Balanophoraceae y Moraceae.

INTRODUCTION

Dominican amber is well known as a preservative agent of both animal and plant remains. Flowers may retain their structural details so clearly that they often can be assigned to extant genera (Poinar 1992) and can be used in paleontological reconstructions (Poinar & Poinar 1999).

During an investigation of floral remains in Dominican amber, we discovered a complete, globose male inflorescence of uncertain affinity. Its morphology is compared with the families Balanophoraceae and Moraceae, with which it shares many essential characteristics. The fossil's exceptional preservation allows microscopic study of the flowers, which are here illustrated. Due to its unique combination of features, the plant is described below as a new genus and species.

MATERIALS AND METHODS

The fossil originated from mines in the northern mountain range (Cordillera Septentrional) of the Dominican Republic, between the cities of Puerto Plata and Santiago. Dating of Dominican amber is controversial, with the youngest proposed age of 20–15 mya based on foraminifera (Iturralde-Vincent & MacPhee 1996) and the oldest as 45–30 mya based on coccoliths (Cêpek in Schlee 1999). Most of the amber is secondarily deposited in turbiditic sandstones of the Upper Eocene to Lower Miocene Mamey Group (Draper et al. 1994).

The amber piece containing the fossil is rectangular in outline, measuring 15 mm in length, 10 mm in width and 8 mm in depth. The holotype is deposited in the Poinar amber collection maintained at Oregon State University.

J. Bot. Res. Inst. Texas 2(2): 1167 – 1173. 2008

DESCRIPTION

Trochanthera G.O. Poinar, K.L. Chambers & A.E. Brown, gen. nov. Type Species: *Trochanthera lepidota* G.O. Poinar, K.L. Chambers & A.E. Brown, sp. nov.

Diagnosis.—Stem leafless and minutely puberulent, total length unknown. Head depressed-globose, completely covered with persistent glabrous, flat-topped, closely connivent bracts in ± a hexagonal pattern. Staminate flowers numerous, emerging over the entire head from between the edges of the bracts, each consisting of a column of distally connivent filaments and 3–4 anthers; anthers connivent, not fused, each with 2 ovate, unilocular thecae dehiscing extrorsely by longitudinal slits. Perianth represented by a short, truncate, erose sheath enclosing base of emergent filament column. Pistillate flowers unknown, absent from the described head or hidden beneath the bracts.

Trochanthera lepidota G.O. Poinar, K.L. Chambers & A.E. Brown, sp. nov. (**Figs. 1–6**). Type: HISPANIOLA. Dominican Republic: amber mine in the northern mountain ranges (Cordillera Septentrional), 1995, unknown amber miner *s.n.* (holotype: catalogue number Sd-9-148A, deposited in the Poinar amber collection maintained at Oregon State University, Corvallis, Oregon 97331, U.S.A.).

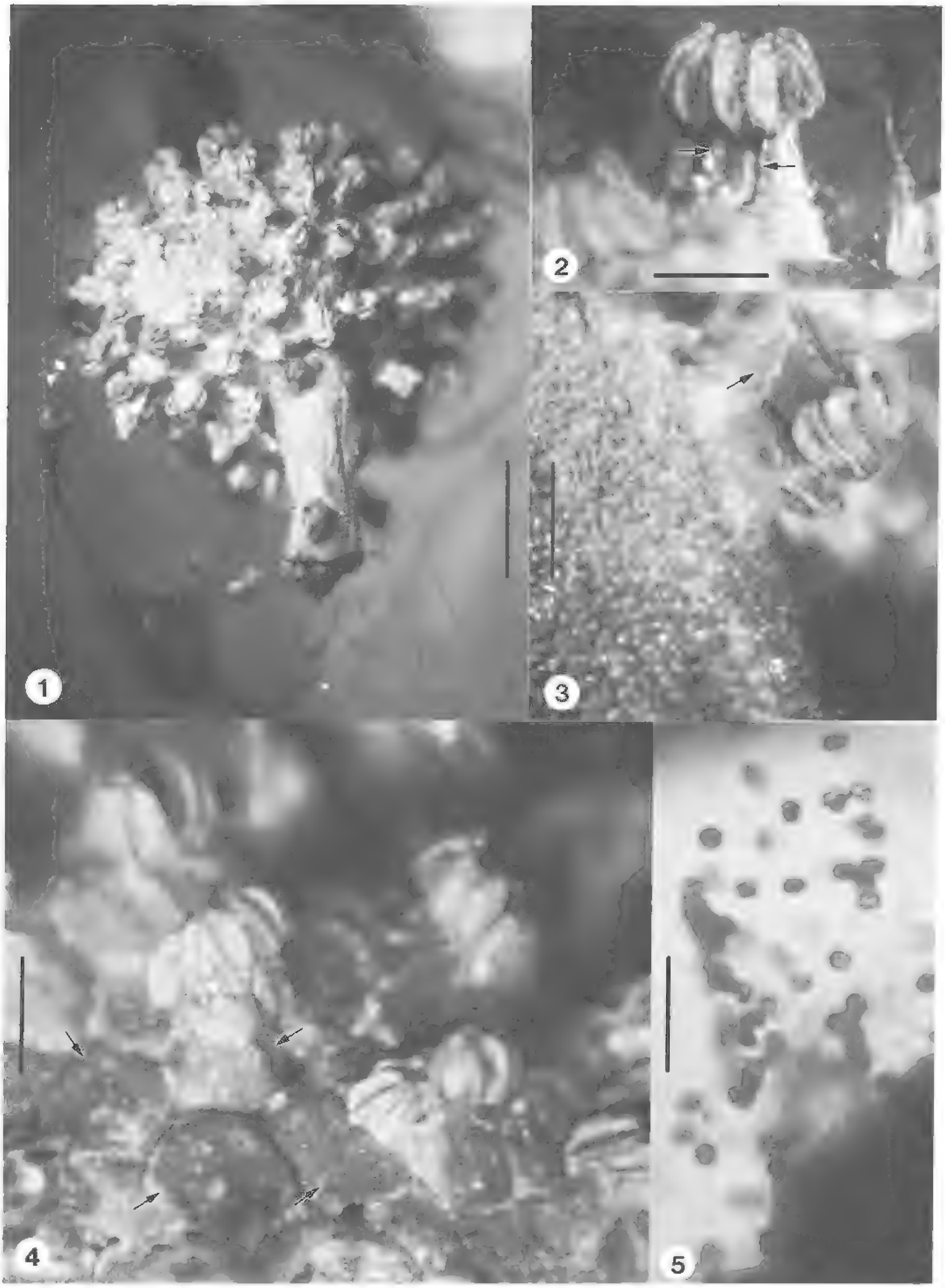
Description.—**Staminate flower head:** width 7.3 mm, length 5.3 mm; attached stem piece 2.6 mm long, 1.2 mm thick; peltate bracts of inflorescence 408(371–468) µm in diameter, anthers of emergent stamens 280(226–323) µm long, 113(96–145) µm wide; length of exposed filaments 0–193 µm; perianth a short (up to 60 µm) sheath enclosing base of filament column; pollen grains spherical, 5–12 µm in diameter, out of position for detailed view of exine morphology.

Etymology.—Genus name from Greek "trochos" ball, and "antheros" flowery. Species name from Greek "lepidotos" scaly.

DISCUSSION

We consider the fossil's distinctive unisexual inflorescence, consisting of a small, globose receptacle completely covered with flat-topped (presumably peltate) bracts, between which project numerous simple staminate flowers, to have its closest analogs in two modern angiosperm groups—family Balanophoraceae and family Moraceae, tribe Dorstenieae (formerly Brosimeae). Both these groups have modern representatives in the Caribbean region. We have not been able to identify a modern genus to which the fossil can confidently be assigned, although it shares characteristics with both families. The following discussion, where *Trochanthera* is compared with each of these putative relatives, calls attention to the striking parallelisms in inflorescence morphology between the two taxa, which otherwise differ markedly in habit—small holoparasitic herbs versus tall tropical forest trees.

Balanophoraceae are a morphologically distinctive group of holoparasitic angiosperms occurring in tropical and subtropical regions of the Old and New Worlds (Hooker 1856; Engler 1889; Harms 1935, Nevling 1960; Kuijt 1969; Hansen 1976, 1980; Nickrent 1997 onwards; Stevens 2001 onwards; Gonzáles 2004). They are obligate subterranean parasites, usually forming a tuberous attachment to host roots from which naked or bracteate inflorescence-bearing stems arise. By upward growth of the stem, the flowering portion is exposed at the soil surface or elevated on a fleshy, usually upright stalk, the plants at this stage often being described as "mushroom-like." Inflorescences are variously shaped, forming a loose or compact (tightly branched) raceme in some genera and a flat-topped or club-shaped to spherical head in others (Kuijt 1969, p. 125). The flowers are unisexual, the plants being dioecious or monoecious with the two sexes, in the latter case, either mixed or in separate parts of the inflorescence (or on separate heads from the same tuber). Pistillate flowers, in particular, are often minute and extremely numerous, while the usually synangial anthers of staminate flowers take a great diversity of forms (Kuijt 1969, pp. 128, 130). A 3–6-lobed perianth is most often present in staminate flowers and may act as a protective covering over the anthers as the young inflorescence pushes through the soil. A different kind protection for such inflorescences, occurring, for example, in the New World genera *Helosis* and *Corynea*, is a complete covering of peltate bracts, fitting tightly edge-to-edge in a geometric pattern and giving the capitulum a somewhat pineapple-like appearance



Figs. 1–5, *Trochanthera lepidota*. **1.** Entire flowering head. Scale bar = 1.4 mm. **2.** Group of stamens showing edges of connivent filaments (arrows). Scale bar = 150 µm. **3.** Stamens at base of head adjacent to minutely puberulent stem, showing perianth sheath surrounding the filament column (arrow). Scale bar = 180 µm. **4.** Portion of head showing peltate bracts (arrows) with anthers emerging between their margins. Scale bar = 360 µm. **5.** Pollen grains adjacent to anther. Scale bar = 50 µm.

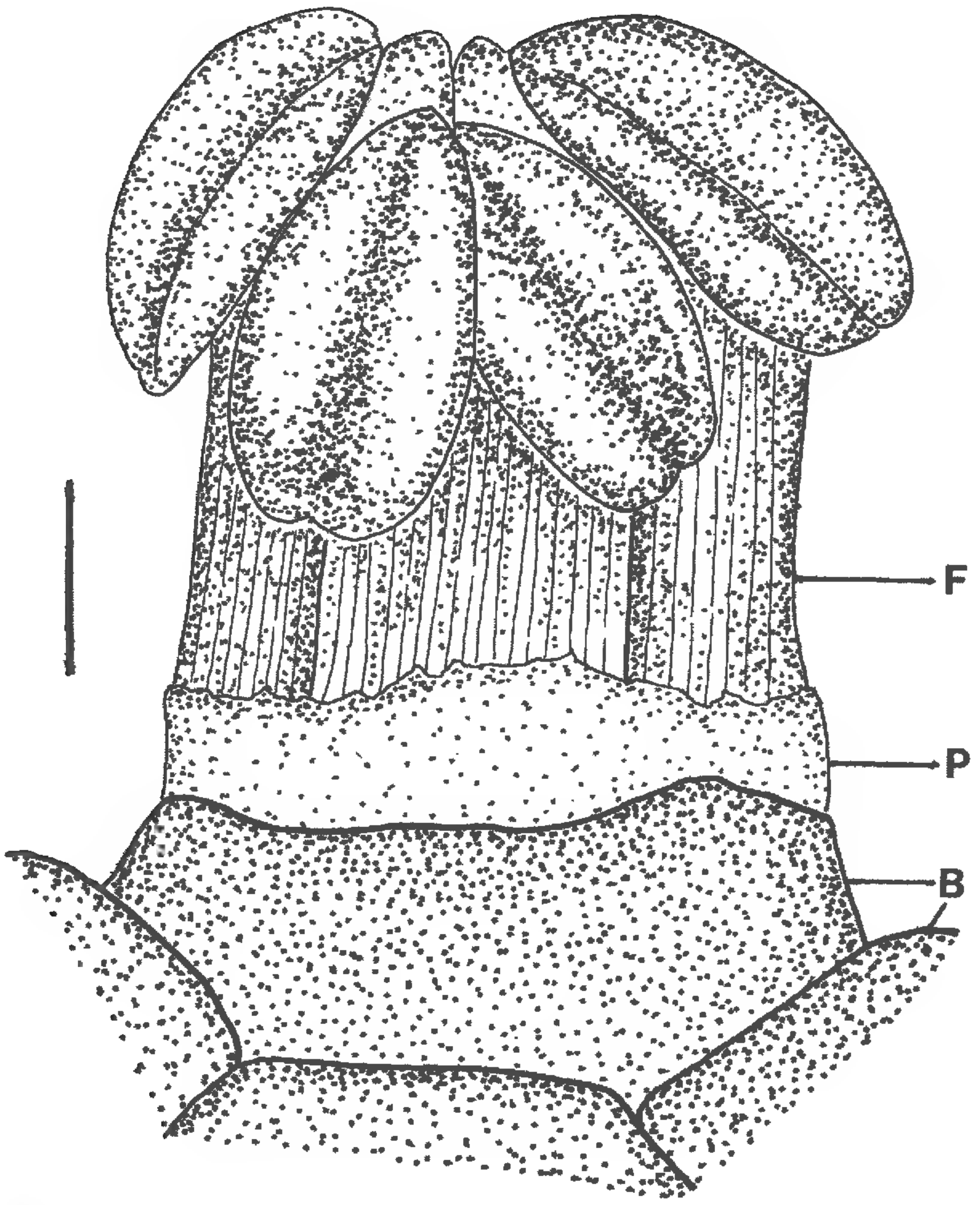


Fig. 6. *Trochanthera lepidota.* Individual flower showing dehisced anther thecae, connivent filament column (F), delicate perianth sheath (P), and portions of peltate bracts (B). Scale bar = 130 µm.

(Hooker 1856, pls. XIII, XV; Hansen 1980, fig. 11). The development and function of these bracts is well described by Hansen (1978). In the two genera mentioned above, the peltate bracts are deciduous following emergence of the capitulum, and the small staminate flowers then become evident as they emerge from a dense, mat-like covering of clavate hairs (Hooker 1856, pl. XIII). The tiny pistillate flowers remain embedded in these hairs with only the styles and stigmas exposed.

Trochanthera differs from the condition described for *Helosis* and *Corynea*, among others (see Hansen 1978, 1980), in that a covering of tight-fitting bracts persists at anthesis, and the staminate flowers force their way out between the connivent edges of the bracts (Figs. 1–4, 6). In the process, some flowers elongate farther than others, and occasional anthers are broken and left behind, as it were. It seems remarkable that the delicate tubular perianth (Figs. 3, 6) is also able to emerge, at least in some flowers, in the process of the staminal column forcing itself between the bracts. A similar system for the emergence of staminate flowers from between protective bracts occurs in the monoecious species *Balanophora wrightii*, illustrated by Nickrent (1997 onwards), but in it the male flowers are fewer on the head, they possess a broadly 3-lobed perianth, and the anthers form a synandrium with transverse dehiscence, as in some other *Balanophora* taxa. In his discussion of inflorescence structure in the related Asian *Balanophora* species *B. harlandii* and *B. wilderi*, Hansen (1978) refers to the clavate bracts covering the pistillate portion of the heads as “spadicles,” although this usage may be inappropriate (R.K. Eberwein pers. comm.). These intergrade with the broader sub-peltate type in the staminate part of the heads. We cannot be sure to what extent Hansen’s term spadicles applies to *Trochanthera*, and we prefer the term peltate bracts even though their 3-dimensional form cannot be determined from the fossil.

The stamens of Balanophoraceae are extremely diverse, especially in the construction of the anthers.

Anthers similar to those of *Trochanthera* are found in the South African genus *Mystropetalon*; that is, they are of an unspecialized, bithecal type, dehiscent extrorsely through two longitudinal slits. *Mystropetalon* happens also to be characterized by the putatively plesiomorphic trait of male and female flowers each with vestigial organs of the opposite sex (Nickrent et al. 2005; Kuijt 1969, p. 127), whereas pistillodes are not present in male flowers of *Trochanthera*. Compared with *Helosis* and *Corynea*, and with the Asian *Balanophora* taxa mentioned above (Hansen 1972), *Trochanthera*'s anthers are notably larger than in the 2 New World genera (see illustrations in Hooker 1856; Hansen 1980) and are extrorse rather than introrse (Figs. 1–4, 6). The anthers are not fused into a synandrium that releases pollen through horseshoe-shaped or transverse slits, pores, etc., as is common in *Balanophora* (Hansen 1972). The filaments of the fossil may be proximally fused, as in these other genera, but are only closely connivent distally (Figs. 2–4, 6).

The short, tubular, sheathing, unlobed perianth of *Trochanthera* most resembles that of *Corynea crassa* Hook. f. var. *crassa* (Hooker 1856, pl. XIII; Hansen 1980, fig. 11). On the other hand, a prominently 3-lobed type is characteristic of staminate flowers in *C. crassa* var. *sprucei* and also of *Helosis*, while in *Mystropetalon* and *Balanophora* species the perianth is well developed and 3–6-lobed. An unlobed, sheathing perianth is present in staminate flowers of the Asian *Rhopalocnemis* (Harms 1935, fig. 163), but its anthers form a single multichambered synangium.

The stalk or stem of *Trochanthera* is leafless, at least distally (Fig. 1). This is comparable to various genera of Balanophoraceae (Hooker 1856; Kuijt 1969; Hansen 1980; Nickrent 1997 onwards). More or less bracteate stems are also common in the family.

A remarkably similar form of staminate inflorescence to the above occurs in the *Brosimum* alliance of Moraceae, tribe Dorstenieae (Berg 1989; Rohwer 1993; Datwyler & Weiblen 2004; Zerega et al. 2005; formerly Brosimeae of Engler 1889; Hutchinson 1967; Berg 1972). Congested, often globose flowering heads are frequent in Moraceae, as for example the members of tribes Castilleae (Olmedieae) and Dorstenieae (Brosimeae) described and illustrated by Berg (1972). Heads may be bisexual (one or more pistillate flowers mixed with the staminate ones) or unisexual (staminate or pistillate only, Berg 1989, fig. 11.3). These are borne on short, axillary peduncles, one to several per node (Woodson 1960; Berg 1972) and are in the same size range as *Trochanthera*. Because of the covering of peltate bracts in *Trochanthera*, between which the staminate flowers emerge, the most promising comparisons are with similarly bracteate *Brosimum* species. Other genera having small, globose heads of male flowers, such as *Coussapoa* (Woodson 1960, now in family Cecropiaceae; Rohwer 1993; Datwyler & Weiblen 2004), *Helicostylis* of tribe Dorstenieae (Olmedieae of Berg 1972), or *Poulsenia* (Woodson 1960, assignable to tribe Castilleae per Datwyler & Weiblen 2004) lack peltate bracts and have flowers with a 3–4-parted perianth and stamens either free and more numerous or 1–2 and often connate.

The *Trochanthera* inflorescence appears completely staminate, whereas species of *Brosimum* often, but not always, have bisexual heads with a single, deeply embedded pistillate flower accompanying numerous staminate ones. However, the style of this female flower may wither early, and the head may then appear staminate. Woodson (1960, p. 130) quotes Standley as to the difficulty of finding "with ordinary herbarium specimens…even one pistillate flower." We could not find an exposed style in the fossil.

Flowers with 2–4 stamens occur in *Brosimum* species of section *Brosimopsis* (genus *Brosimopsis* of Hutchinson 1967, p. 172), but a well developed, 4-lobed, pubescent perianth is present, and stamens are clearly separate with slender filaments (Berg 1972, p. 178). In section *Piratinera* (Berg 1972, p. 181) a perianth is absent in the staminate flowers and may be replaced by an enclosing bract (e.g., *B. gaudichaudii*, p. 185). However, there is only 1 stamen, which has a broad anther connective unlike *Trochanthera*. Other *Brosimum* species with a reduced or absent perianth and only 1 stamen are found in section *Brosimum* (Berg 1972, p. 169); they differ from *Trochanthera* in having either a peltate anther (*B. alicastrum*) or a tiny one only 0.2 mm in length and breadth (*B. acutifolium*). The peltate bracts of these and other *Brosimum* taxa differ from *Trochanthera* in being circular in outline, rather than closely connivent and more or less hexagonal (Woodson 1960, pp 131–133; Berg 1972, figs. 62, 66, 71, 73). In *Brosimum* subgenus *Ferolia* (Berg 1972, p. 188) the stamens, if more than 1, are divergent with slender filaments. The sheathing perianth, if present, is minutely ciliate apically. The peltate bracts are usually puberulent. The stamen, if 1, usually has the anther bent at 90°, with a thickened connective (all data from Berg 1972). In this comparison, therefore, the fossil cannot be accommodated in the genus *Brosimum*, and its description as a separate taxon is supported.

Recognition of *Trochanthera* as a distinct genus will assist in future comparison of this unique fossil with extant members of Balanophoraceae and Moraceae, both of which are diverse in floral morphology and inflorescence structure. In Balanophoraceae, we prefer not to assign the plant to a variable modern genus like *Balanophora* (Hansen 1972), since taxonomic circumscriptions may change in the future, especially when DNA methods are applied to the family. A principal authority on the family, Bertel Hansen, was admittedly conservative in his taxonomic approach (Friis 2006), and he merged 9 later synonyms into the single genus *Balanophora*. Additionally, other generic unions have recently been proposed (Eberwein & Weber 2004), which strengthen Old and New World taxonomic affinities in the family. Further, when comparing *Trochanthera* with representatives of Moraceae, it is again unclear that a close relationship exists between it and particular modern genera, including *Brosimum* and allied taxa.

Molecular studies of the phylogenetic relationships of parasitic angiosperm families have advanced rapidly in recent years (summarized in Barkman et al. 2007). Based on such work, the Balanophoraceae have been firmly assigned to order Santalales (Nickrent & Franchina 1990; Nickrent 1997 onwards; Stevens 2001 onwards), but their exact position was uncertain until the work of Nickrent et al. (2005). Based on 4 loci from the plastid, nuclear, and mitochondrial genomes, this study clearly placed 3 selected members of this family within a clade containing 3 genera representative of Santalaceae, Olacaceae, and Loranthaceae.

Knowledge of the relationships of Moraceae with allied families, and of generic groups within the family, has been clarified by recent molecular studies (Sytsma et al. 2002; Datwyler & Weiblen 2004; Zerega et al. 2005). Changes in the familial and tribal assignments of certain genera mentioned above are based on Datwyler and Weiblen (2004) and Zerega et al. (2005). The latter paper involved a combined phylogenetic analysis of 26S and *ndhF* gene sequences and included proposals for phylogeography and divergence times of the higher taxa. For Moraceae tribe Dorstenieae, a stem group age of 48 mybp was estimated, while for *Brosimum* and its 2 closest relatives, the crown group age was placed at 28 mybp. Because the family placement of *Trochanthera* is uncertain, and our analysis may not have exhausted all possibilities, we can only point out that the fossil falls within an age of interest for presumed evolutionary diversification in both of the families discussed above. Morphological parallelisms abound in the angiosperms, and in this case, a similar form of inflorescence in quite different families prevents us from proposing a more exact assignment for this distinctive Tertiary fossil.

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BOOK NOTICE

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CRETACIFILIX FUNGIFORMIS GEN. AND SP. NOV., AN EUPOLYPOD FERN (POLYPODIALES) IN EARLY CRETACEOUS BURMESE AMBER

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ABSTRACT

An eupolypod fern, **Cretacifilix fungiformis** gen. & sp. nov. (Polypodiales) is described from four partial, fertile leaf blades in a piece of Early Cretaceous Burmese amber. Diagnostic characters are: oval, thick-walled sporangia with vertical, short annuli not extending more than half the circumference of the sporangia, deeply embossed, circular sori with brown, multicellular, round to reniform, persistant indusia attached at the sinus and ruggose-tuberculate, oval, monolete spores. This discovery shows that eupolypod ferns and angiosperms were evolving concurrently at the Burmese amber site in the Early Cretaceous.

Key Words: amber, Myanmar, Early Cretaceous, eupolypod fern

RESUMEN

Se describe un helecho eupolypodioide, **Cretacifilix fungiformis** gen. & sp. nov. (Polypodiales) a partir de cuatro partes de hojas fértiles, de una pieza de ámbar del Cretácico temprano de Birmania. Los caracteres diagnósticos son: esporangios ovales con pared gruesa con anillos verticales cortos que no se extienden más de media circunferencia de los esporangios, soros circulares profundamente labrados, con indusios persistentes marrones, multicelulares, de redondos a reniformes, unidos en el seno, y esporas monoletas, ovales, rugoso-tuberculadas. Este descubrimiento muestra que los helechos eupolypodioides y las angiospermas evolucionaron simultáneamente en el Cretácico temprano en el lugar del ámbar birmano.

INTRODUCTION

Amber from Burma (Myanmar), which has been known for centuries, contains a variety of insect and plant fossils (Poinar et al. 2006). A recent discovery revealed the remains of four fertile pinnules of an eupolypod fern in a piece of Burmese amber. Fern remains are rare in amber and only three species have been described. They are *Alethopteris serrata* Caspary (1881) and *Pecopteris humboldtiana* Göppert and Berendt (1845) from Eocene Baltic amber (both of the above extinct genera had been established previously for Carboniferous ferns) and *Grammitis succinea* Gómez (1982) in Miocene-Oligocene Dominican amber.

The present study describes the Burmese amber fern using characters associated with the sori, indusia, sporangia and spores.

MATERIALS AND METHODS

The amber was derived from a mine first excavated in 2001, in the Hukawng Valley, southwest of Maingkhwan in the state of Kachin (26°20'N, 96°36'E) in Burma (Myanmar). This new amber site, known as the Noije Bum 2001 Summit Site, was assigned to the Upper Albian of the Early Cretaceous on the basis of paleontological evidence (Cruickshank & Ko 2003). Nuclear magnetic resonance (NMR) spectra and the presence of araucaroid wood fibers in amber samples from the Noije Bum 2001 Summit site indicate an araucarian (probably *Agathis*) tree source for the amber (Poinar et al. 2007).

The single piece of amber containing the fern remains (Fig. 1) was roughly rectangular in shape, measuring 12 mm long, 6 mm wide and 1 mm in depth. Observations, drawings, and photographs were made with a Nikon SMZ-10 R stereoscopic microscope and Nikon Optiphot compound microscope (with magnifications up to 700×). It is not possible to determine whether the blades were pinnate, bipinnate or tripinnate. The lengths of the four fertile pinnules in the amber are: pinnule A, 3 mm; pinnule B, 4.9 mm; pinnule C, 5.2 mm and pinnule D, 2.4 mm. Each pinnule contains one or more sori on their abaxial surfaces (Figs. 1, 5).

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DESCRIPTION

Cretacifilix G.O. Poinar & R. Buckley, gen. nov. Type Species: *Cretacifilix fungiformis* G.O. Poinar & R. Buckley (Polypodiales).

Diagnosis.—Rhizome, stipe, rachis and costa unknown. Fronds of unknown length; pinnules lobed, mostly glabrous with few scattered unicellular hairs on surface and margins; veins free, not reaching margins, not ending in hydathodes; sori medial, orientated mostly in alternate positions in two rows, with mostly one, but sometime two sori bone on single pinnule lobe, deeply embossed, resulting adaxial pustules at ends of veins; sori covered by brown, thick, glabrous, multicellular, round to reniform, persistant indusia with stalk attached by inner end of sinus with distal and lateral openings; some indusia bent backwards, revealing ribbed stalks; sporangial stalks composed of 1–3 rows of cells; sporangia oval, thick-walled, walls composed of small, narrow, elongate cells; annulus vertical, short, broad, not extending more than half circumference of sporangia, with less than 10 thick walled cells; spores small, oval, ruggose-tuberculate, monolete.

Cretacifilix fungiformis G.O. Poinar & R. Buckley, sp. nov. (**Figs. 1–5**). Type: MYANMAR. Kachin: Noije Bum 2001 Summit Site in the Hukawng Valley, SW of Maingkhwan in the state of Kachin (26°20'N, 96°36'E), 2005–2007, *collector unknown* (holotype: catalogue # B-11, amber collection of Deniz Erin in Istanbul 34744, Turkey). This collection is available for study. Further contact information can be obtained from Ron Buckley at ronbuckley@fuse.net.

Description.—**Four fertile pinnules:** indusia (N = 22) opening outward, 416(360–504) µm in width, 233 µm in length; indusial stalk 142(104–208) µm wide, width of cap, 183(90–436) µm; cells of indusia thick walled, many filled with discrete, minute bacilliform bodies ranging from 3–4 µm in length and 1–2 µm in width; stalk of indusia often ribbed (possibly from desiccation); sporangia oval-shaped; capsule walls composed of thick walled, narrow, elongate cells; sporangia (N = 10), 158(140–189) µm in length, 115(81–150) µm in width; annulus short, containing less than 10 thick-walled cells and extending no more than half circumference of sporangia; length annulus (N = 5), 53(24–72) µm; width annulus (N = 3), 53(24– 72); spores (N = 8) monolete, oval, 21(16–29) µm long and 14(11–20) µm wide, surface ruggose-tuberculate, perispore not evident; hairs on margins and veins of pinnules range from 28–195 µm in length.

Etymology.—*Cretacifilix* is derived from the Latin Cretaceus for "chalky" indicating the Cretaceous period and from the Latin "filix" for fern: *fungiformis* is derived from the Latin "fungi" for mushroom and the Latin "forma" for shape in reference to the resemblance of the indusia to fruiting bodies of chanterelles and some shelf-like mushrooms.

DISCUSSION

Since the vegetative structures and habit of *Cretafilix* are unknown, systematic placement is based on the reproductive characters. The presence of a vertical annulus that partially encircles the spore case (Figs. 2, 5) places the fossil in the Eupolypods clade of the Polypodiales (Schneider et al. 2004; Smith et al. 2006). It was not possible to place *Cretacifilix* in an extant family because of its unique combination of characters. Surficial sori with reniform indusia are characters of the families Dryopteridaceae and Woodsiaceae (and are also known from some members of the Thelypteridaceae, Tectariaceae and Lomariopsidaceae) as defined by Smith et al. (2006). However members of the Dryopteridaceae and Woodsiaceae possess reniform, trilete spores and the spores of *Cretacifilix* are oval and monolete. Also the indusia of these families are usually not multicellular and thick as with *Cretacifilix* (Bower 1928; Sledge 1973).

Another character of *Cretacifilix* not found in the Dryopteridaceae or Woodsiaceae is the deeply embossed sori (Plate 2). This character closely resembles that found in the North American *Pleopeltis polypodioides* (L.) E.G. Andrews & Windham of the Polypodiaceae (Cobb et al. 2005). This species, commonly known as the resurrection fern, has the characteristic of curling up and appearing dead during periods of drought, but then recovering when conditions are favorable. If embossed sori are associated with survival during periods of aridity, it would suggest that *Cretacifilix* might have been subjected to similar climatic conditions. The resurrection fern occurs on tree branches (Cobb et al. 2005), which is a likely habitat for *Cretacifilix* and would explain how fronds of the fossil made contact with resin on the trunk of the araucaroid tree.

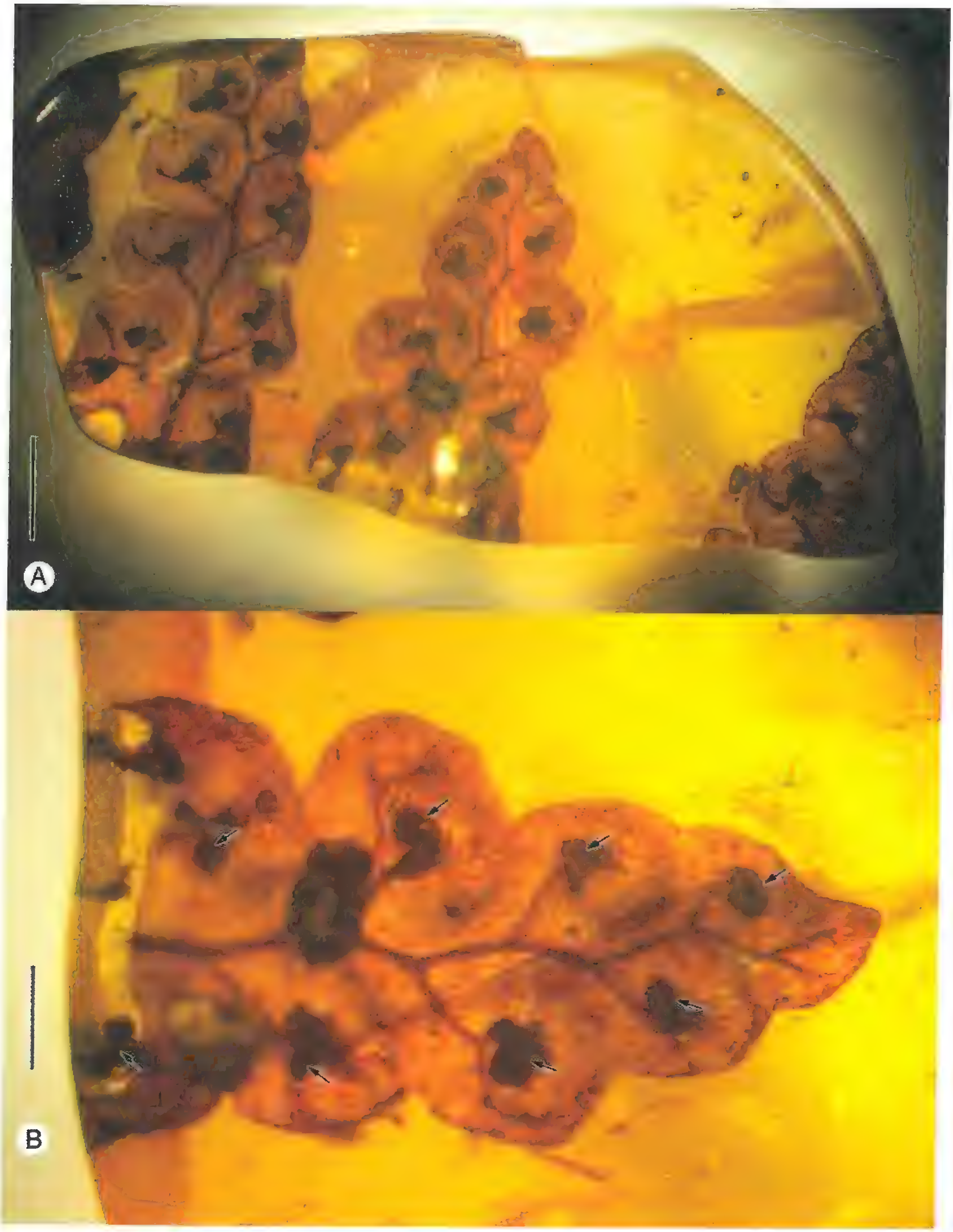

Fig. 1. *Cretacifilix fungiformis*. **A.** Burmese amber piece with four partial pinnules (A,B,C,D, from left to right). Scale Bar = 1.2 mm. **B.** Pinnule B. Arrows show brown, persistent indusia. Scale Bar = 0.6 mm.

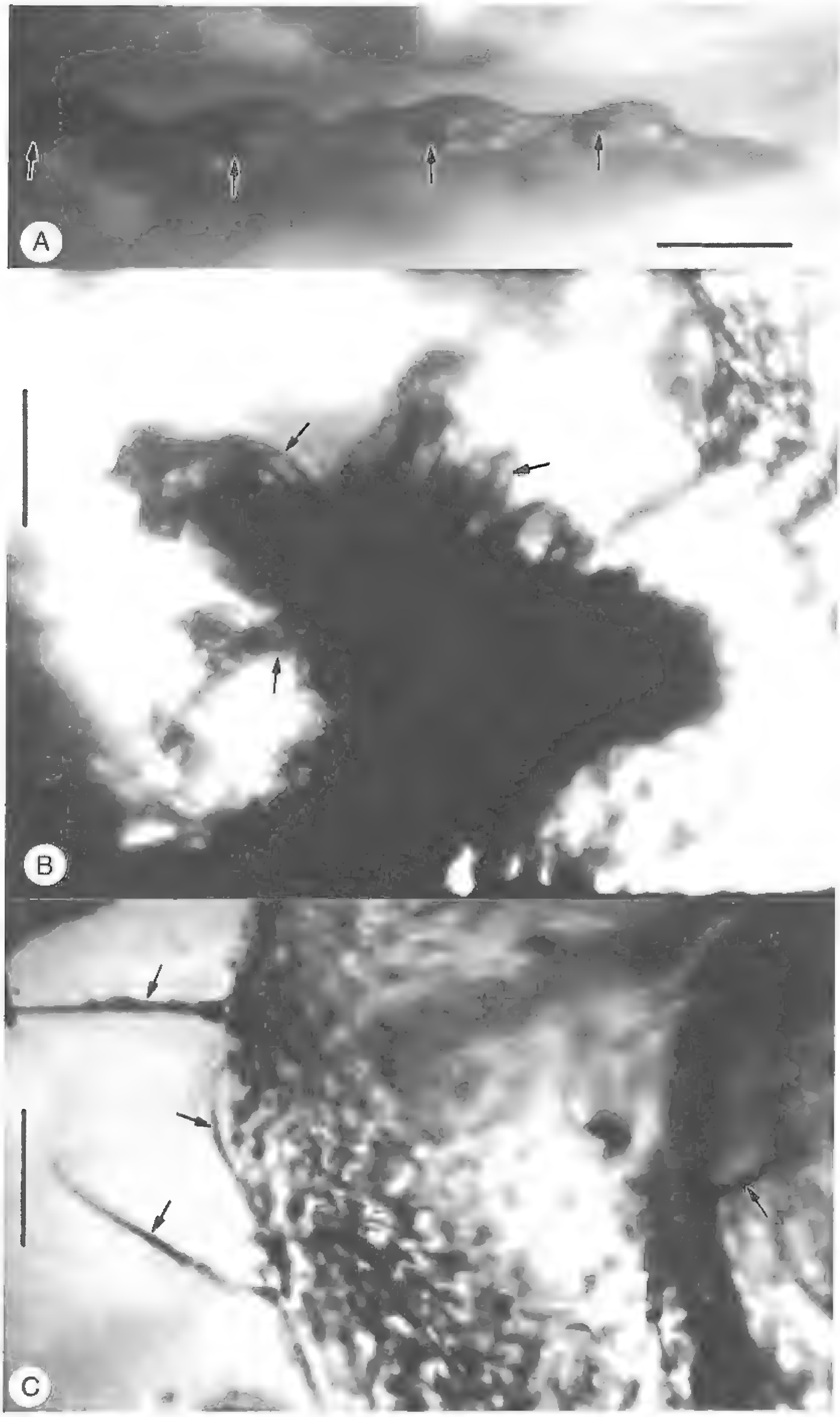

FIG. 2. *Cretacifilix fungiformis*. **A.** Pustles on the adaxial surface of pinnule **B.** Arrows show sori on abaxial surface. Scale Bar = 1 mm. **B.** Indusium with remains of sporangial stalks (arrows) protruding from edges. Scale Bar = 110 µm. **C.** Hairs (arrows) on margins and vein of pinnule. Scale Bar = 62 µm.

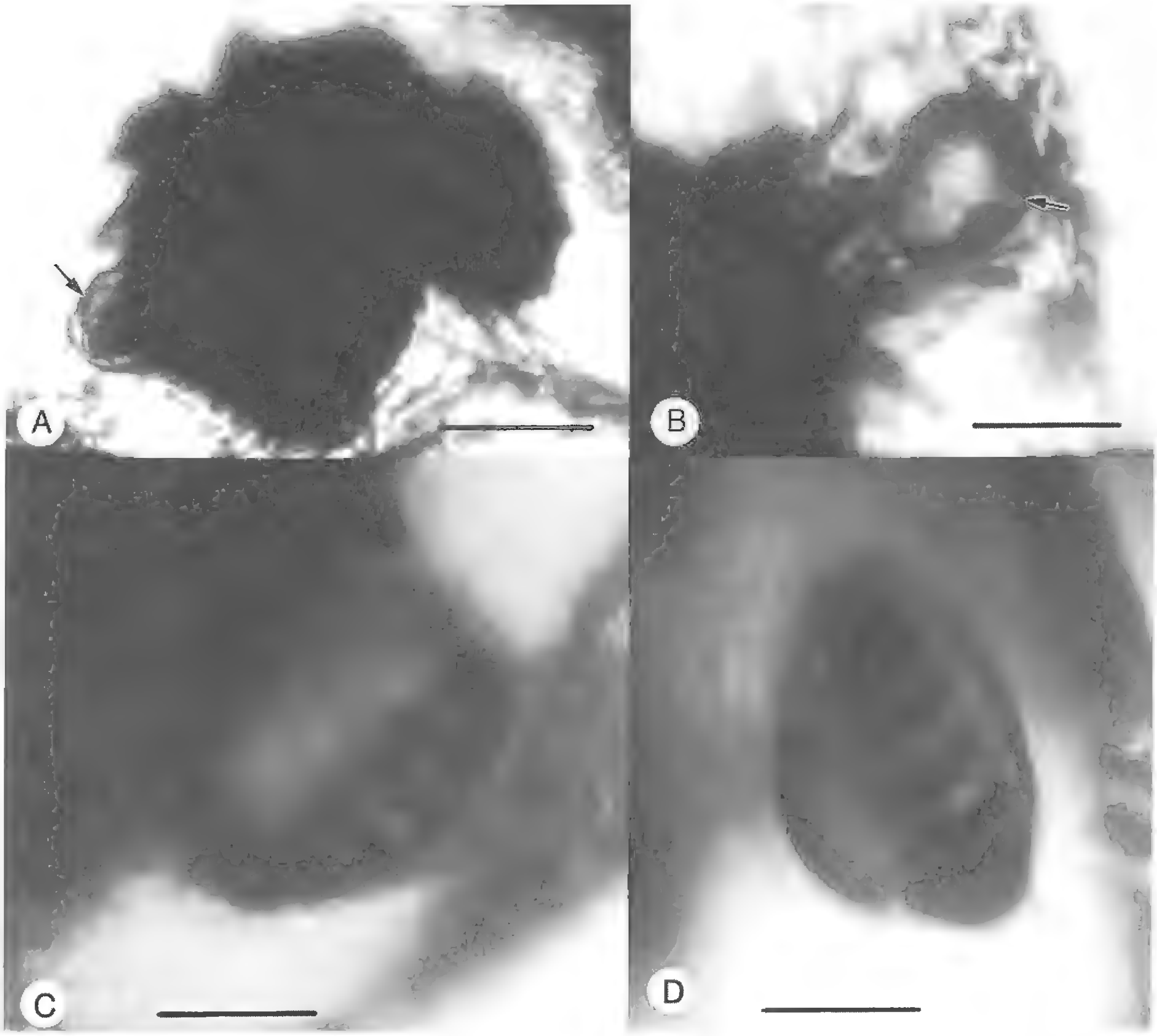

Fig. 3. ***Cretacifilix fungiformis.*** **A. Indusium with partly protruding sporangia (arrow). Scale Bar = 60 µm. B. Sporangium with opening on side of capsular wall. Arrow shows annulus. Scale Bar = 126 µm. C. Lateral view of sporangium with annulus. Scale Bar = 73 µm. D. Vertical view of sporangium with annulus. Scale Bar = 53 µm.**

Asian dryopterid species with similar sori are *Arachniods standishii* (Moore) Ohwi, *Dryopteris lacera* (Thumb.) O. Kuntze and *Dry opteris chinensis* (Bak.) Koidz. However, in the former two species, the veins extend to the tips of the pinnules and the sori are either on the veins or in opposite rows, and in the latter species, the annulus has 17 thick- walled cells and extends more than half way around the circumference of the sporangium (Lee 1999).

The annulus of extant leptosporangiate ferns extends at least two thirds around the circumference of the sporangial capsule (Moran 2004). The short annuli, thick, narrow cell walls of the sporangial capsules and small, oval spores appear to be unique features of *Cretacifilix*. The small bacilliform bodies in the indusial cells could indicate a symbiotic association. No reports of similar bodies in the indusial cells of extant ferns could be found.

The presence of an eupolypod fern in the Early Cretaceous supports other records of fossil Polypodiales ferns from the same period (Deng 2002). Based on molecular studies, eupolypod subclades are thought to have diversified in the Late Cretaceous (Schneider et al. 2004), but it is obvious that they were already present in the Early Cretaceous and evolving concurrently with early angiosperms, several of which have

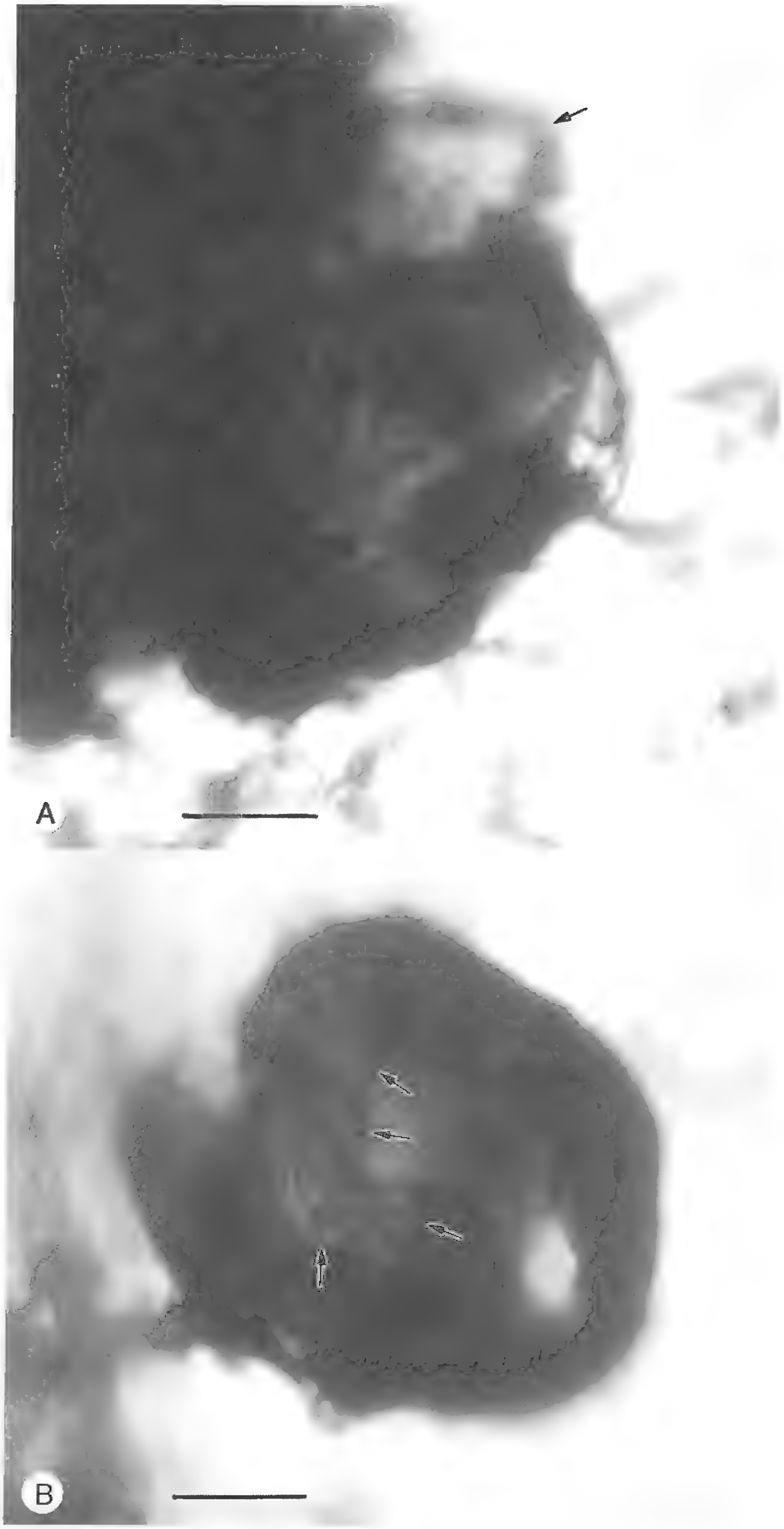

Fig. 4. *Cretacifilix fungiformis.* **A.** Sporangium wall composed of narrow, elongate cells. Arrow indicates stalk. Scale Bar = 37 µm. **B.** Sporangium with a portion of wall removed, revealing four spores (arrows). Scale Bar = 25 µm.

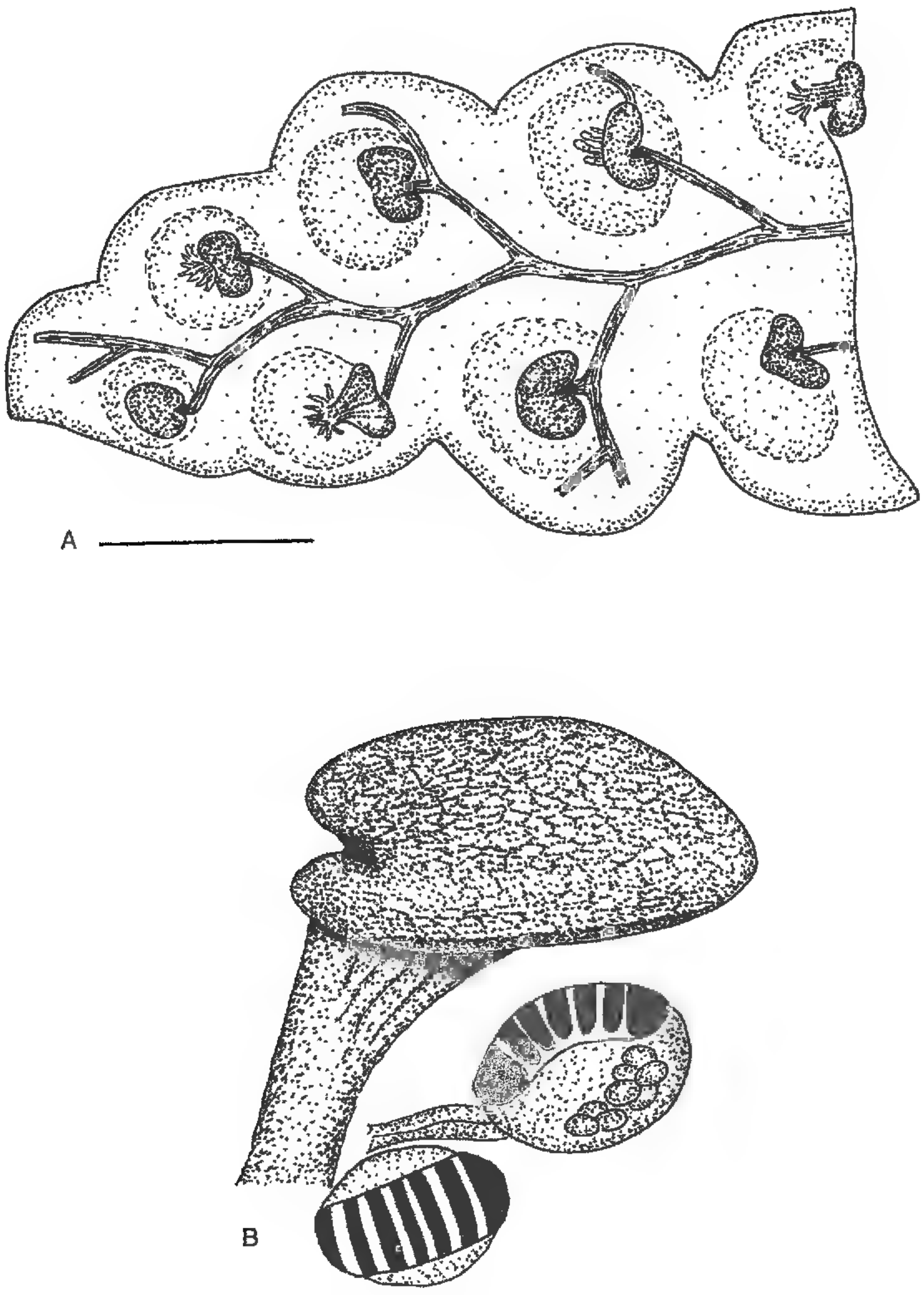

Fig. 5. ***Cretacifilix fungiformis.*** **A. Pinnule B showing veins and indusia. Scale Bar = 0.6 mm. B. Partial reconstruction of stalked indusium and two sporangia, one of which contains 8 spores (proportions maintained).**

been recovered from the same Burmese amber fossil site (Poinar 2004; Poinar & Chambers 2005; Poinar et al. 2007).

All evidence indicates that the Burmese amber forest was a tropical-subtropical rainforest with many floral characteristics of the Waipoua kauri forest in Northern New Zealand. The Waipoua forest is the only virgin *Agathis* forest in the world today and comprises a mixed dense ecosystem of flowering plants, ferns, lycopods and moss on 90 sq km of land. Of the 241 plants that have been recorded, 178 species are seed bearing and 63 are ferns or lycopods (McGregor 1948).

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AN EARLY CRETACEOUS ANGIOSPERM FOSSIL OF POSSIBLE SIGNIFICANCE IN ROSID FLORAL DIVERSIFICATION

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ABSTRACT

Lachnociona terriae gen. & sp. nov. is described from an Early Cretaceous flower preserved in Burmese amber. *Lachnociona* is represented by a small, hirsute, functionally pistillate flower with 5 strongly recurved perianth parts, 10 staminodial filaments, and a 5-carpellate pistil with 5 stout, erect, connivent or connate styles, their sharply acute, recurved tips presumably with decurrent ventral stigmas. The gynoecium is densely lanate-hirsute. Three of the filaments show thin pieces of vestigial anther tissue at their tips. The perianth is interpreted as a calyx, with the corolla absent. Possible relationships are discussed, focusing on the families Brunelliaceae and Cunoniaceae (order Oxalidales), and on selected examples from 2 other rosid orders plus Saxifragales.

RESUMEN

Se describe **Lachnociona terriae** gen. & sp. nov. a partir de una flor conservada en ámbar del Cretácico temprano de Birmania. *Lachnociona* está representada por una flor pequeña, hirsuta, funcionalmente pistilada con perianto de 5 partes fuertemente recurvadas, 10 filamentos estaminodiales, y un pistilo 5-carpelado con 5 estilos fuertes, erectos, conniventes o connatos, con los extremos muy agudos y recurvados, presumiblemente con estigmas ventrales decurrentes. El ginoecio es densamente lanoso-hirsuto. Tres de los filamentos muestran piezas finas de tejido vestigial de la antera en sus extremos. El perianto se interpreta como un cáliz, con la corola ausente. Se discuten las posibles relaciones, centrándonos en las familias Brunelliaceae y Cunoniaceae (orden Oxalidales), y en ejemplos selectos de otros dos órdenes de rósidas y de Saxifragales.

INTRODUCTION

Burmese amber is first mentioned in works dating from AD 100, when an amber trade route was established between that country and China. From AD 100 until 1936, the Burmese amber mines supplied amber for jewelry and fossils. Social upheavals closed the mines for 63 years, but in 1999, extraction procedures began anew. The fossil was derived from a mine first excavated in 2001, in the Hukawng Valley, southwest of Maingkhwan in the state of Kachin (26°20'N, 96°36'E) in Burma (Myanmar). This new amber site, known as the Noije Bum 2001 Summit Site, was assigned to the Upper Albian of the Early Cretaceous on the basis of paleontological evidence (Cruickshank & Ko 2003), placing the age at 97 to 110 mya. Nuclear magnetic resonance (NMR) spectra and the presence of araucarioid wood fibers in amber samples from the Noije Bum 2001 Summit Site indicate an araucarian (possibly *Agathis*) tree source for the amber (Poinar et al. 2007).

Within the past few years, amber from this area has yielded a wealth of arthropod and plant remains (Poinar et al. 2005). While insects dominate, some very interesting angiosperm fossils have been recovered up to now, including flowers with possible affinities to the families Monimiaceae (Poinar & Chambers 2005) and Cornaceae (Poinar et al. 2007), as well as two early bambusoid grasses (Poinar 2004). In the present paper, we describe an additional flower from the same location, with similarities to fossil and extant members of eurosid orders Oxalidales, Cucurbitales, Sapindales, and eudicot order Saxifragales.

MATERIALS AND METHODS

An entire, well-preserved female flower with staminodes (accession # ab-294) is embedded in a round piece

J. Bot. Res. Inst. Texas 2(2): 1183 – 1192. 2008

of amber with a diameter of 40 mm and a thickness of 5 mm. Examination and photographs were made with a Nikon stereoscopic microscope SMZ-10 R at 80× and a Nikon Optiphot microscope at 800×.

DESCRIPTION

Lachnociona G.O.Poinar, K.L. Chambers & R. Buckley, gen. nov. Type Species: *Lachnociona terriae* G.O. Poinar, K.L. Chambers & R. Buckley, sp. nov.

Diagnosis.—Flowers small, pedicellate, unisexual, the type specimen functionally pistillate, 5-merous, actinomorphic, apparently apetalous; sepals 5, regular, separate, ovate-lanceolate, recurved, ciliate, lightly hirsutulous on both surfaces, venation obscure; staminodes 10, in 1 or 2 whorls, filaments conspicuous, slender and tapering, the tip retrorsely hooked in some, the fully preserved ones all non-functional, anthers absent or represented by thin vestigal tissue on 3 staminodes; gynoecium 5-carpellate, densely lanate-hirsute, ovary superior or perhaps half-inferior, it and the disc (if present) concealed by the pubescence, styles connivent or partly united, their tips sharply acute, recurved-divergent in the upper 1/4–1/3, the stigma probably decurrent ventrally; staminate flower and fruit unknown.

Lachnociona terriae G.O.Poinar, K.L. Chambers & R. Buckley, sp. nov. (**Figs. 1–4**). Type: MYANMAR (Burma): amber mine in the Hukawng Valley; SW of Maingkhwan in the state of Kachin (26°20'N, 96°36'E), northern Myanmar, 2001, *unknown amber miner s.n.* (holotype: accession no. ab-294, Burmese amber, deposited in the collection of Deniz Erin of Istanbul, Turkey, 34744). Arrangements to study the type specimen can be made by contacting Ron Buckley at ronbuckley@fuse.net.

Description.—Flower length 5.6 mm; flower width 5 mm; sepal length 3.60 mm, width 1.8 mm; length of trichomes on sepals 0.25–0.36 mm; staminodes exserted, most broken or chewed off; length of remaining filaments 1.80–1.90 mm; length of vestigial anthers 0.11–0.88 mm; width of largest anther 0.20 mm; length of gynoecial column 3.30 mm; length of divergent upper lobes of style 1.20 mm; length of subtending bract on pedicel 1.10 mm; distance from base of bract to summit of hirsutulous pedicel 2.90 mm.

Etymology.—Genus name from the Greek "lachnos," woolly hair, and "kion," column, with reference to the projecting stylar portion of the gynoecium. Species named in honor of the collector, Mrs. Terri Millinoff.

DISCUSSION

The salient features of the fossil, as described above, are its unisexuality, apparent apetaly, 10 staminodes, densely pubescent, 5-carpellate gynoecium, stout stylar column, and acute, spreading stigmatic lobes. The most reasonable interpretation of the ovary is that it is either superior or, judging from the expanded distal region of the pedicel, half-inferior. The vestigial anther tissue on 3 of the filaments is noteworthy, suggesting unisexuality by abortion, hence derivation from hermaphrodite ancestors. In framing a hypothesis for the systematic position of *Lachnociona*, we have searched for present-day families which best fit the above group of traits, if reasonable assumptions are made about features not clearly visible in the fossil. Because of the thick covering of darkly pigmented hairs, microscopic study of this structure could not resolve the choice between fused or connivent styles. As well, the recurved perianth parts with dark coloration at their base prevented observation of any tiny, outer perianth parts beneath them, and we thus interpret the perianth as a calyx, with the corolla either lacking or deciduous.

Possible candidates have been identified as the closely associated families Brunelliaceae and Cunoniaceae (Oxalidales) (APG II 2003; Stevens 2001 onwards; Soltis et al. 2005), both groups occurring mainly in the Southern Hemisphere with representatives, in the latter case, in the Australian-Southeast Asian region. We interpret the stout, densely hairy, darkly colored (in the fossil) columnar structure to be, all or in part, 5 connivent-appressed styles. The Late Cretaceous fossil *Platydiscus* (Schönenberger et al. 2001; Schönenberger & von Balthazar 2006; Friis et al. 2006) was included in our analysis, because of its initial association with Cunoniaceae. Also, *Anisophyllea* (Anisophylleaceae), of order Cucurbitales, and *Aphanopetalum* (Aphanopetalaceae), of order Saxifragales, came under consideration. *Eurycoma* (Simaroubaceae, order Sapindales) was added for a comparison involving a different interpretation of the perianth of the fossil.

Table 1 summarizes a comparison of floral traits of *Lachnociona* with four living members of Brunelliaceae and Cunoniaceae, together with *Platydiscus*, *Anisophyllea*, *Aphanopetalum* and *Eurycoma*. Brunelliaceae and

Table 1. Comparison of *Lachnociona* with fossil and recent Cunoniaceae (*Platydiscus, Spiraeanthemum, Pullea, Vesselowskya*), Brunelliaceae (*Brunellia*), Anisophylleacaeae (*Anisophyllea*), Aphanopetalaceae (*Aphanopetalum*), and Simarubaceae (*Eurycoma*).

	Lachnociona	***Platydiscus***	***Spiraeanthemum***	***Pullea***
1. Pedicel present - +, absent – 0	+	+	+	+, 0
2. Sepals free - +, connate* – 0	+	+	+, 0	+
3. Sepal number	5	4	4(5)	5(6)
4. Sepals spreading - +, upright – 0	+	+	0	+
5. Petals absent - +, present – 0	+	0	+	+
6. Flowers unisexual - +, bisexual – 0	+	0	+	+
7. Stamen number	10	8	8(10)	10(12)
8. Ovary superior - +, ±, inferior – 0	+ or 0	0	+	0
9. Ovary apocarpous - +, syncarpous – 0	+ or 0	0′	+″	0
10. Carpel number	5	4	(2–3)4 or 5	2
11. Styles united - +, separate – 0	+ or 0	0	0	0
12. Style tips acute - +, capitate – 0	+	+°	0	+
13. Stigma decurrent - +, terminal – 0	+?	+°	0	0
14. Gynoecium hairy - +, glabrous – 0	+	+	+	+
15. Free styles connivent - +, spreading – 0	+?	+°°	0(+)	0(+)[1]

(genera continued)	***Vesselowskya***	***Brunellia***	***Anisophyllea***	***Aphanopetalum***	***Eurycoma***
1.	+	+	0	+	+
2.	+	+	+	+	+(small)
3.	3(4)	(4)5(6)	(3)4(5)	4	5
4.	?	+ or 0	0	0	0
5.	+ or 0[2]	+	0	0(+, small)	+(large)
6.	+	+ (0)	+	0	+(0)
7.	6(8)	(8)10(12)	(6)8(10)	8	5 large
8.	+	+	0	0	+
9.	0	+	0	0	+
10.	2	(3-4)5(6)	(3)4(5)	4	5
11.	0	0	0	+	0 or +[3]
12.	+	+	+	+	+
13.	+	+	+	0	+
14.	+	+	0	0	+
15.	0	0(+)	+	-	+

Footnotes: * – not counting basal fusion to pistil in 1/2 inferior ovaries; ′ – synascidiate below, free above; ″ – laterally connate at base; ° – style tips broken below tip, reconstructed as acute with ventral slit (implying decurrent stigma?); °° – spreading above in reconstruction, but connivent below in figs. 21, 34 in Schönenberger et al., 2001; [1] – connivent when young, see Dickison 1975, fig. 15h; [2] – female flowers have only sepals, Dickison 1989; [3] – separating in fruit.

References: Cuatrecasas 1970; Dickison 1975, 1989; Engler 1930a,b, 1931; Friis et al. 2006; Hermsen et al. 2006; Heywood 1978, p. 158; Hoogland 1979; Hufford & Dickison 1992; Kubitzki 2004, 2007; Matthews et al. 2001; Matthews & Endress 2004; Nooteboom 1962; Orozco Pardo 2002; Perry 1949; Schönenberger et al. 2001; Smith 1952, 1985; Takhtajan 1996.

Cunoniaceae, sometimes united into one family, have always been considered as closely related in traditional theories of angiosperm phylogeny (e.g., Engler 1930a, b; Thorne 1992; Cronquist 1981). The fossil is similar to *Brunellia* in being unisexual, apetalous, 10-stamened, and having a 5-carpelled, pubescent gynoecium with acute style tips whose stigmatic surface is probably ventral and decurrent. *Brunellia* is apocarpous, the carpels at most being immersed in the disc (Orozco Pardo 2002; Kubitzki 2004). Its separate styles may be vertical in early flower (Cuatrecasas 1970; Kubitzki 2004), with recurved tips. In Cunoniaceae, the carpel number is usually 2 and the stigmas, except for *Vesselowskya*, are terminal and often capitate (Bradford et al. 2004). However, higher carpel numbers are known, e.g., in *Pullea, Aistopetalum, Spiraeanthemum*, and

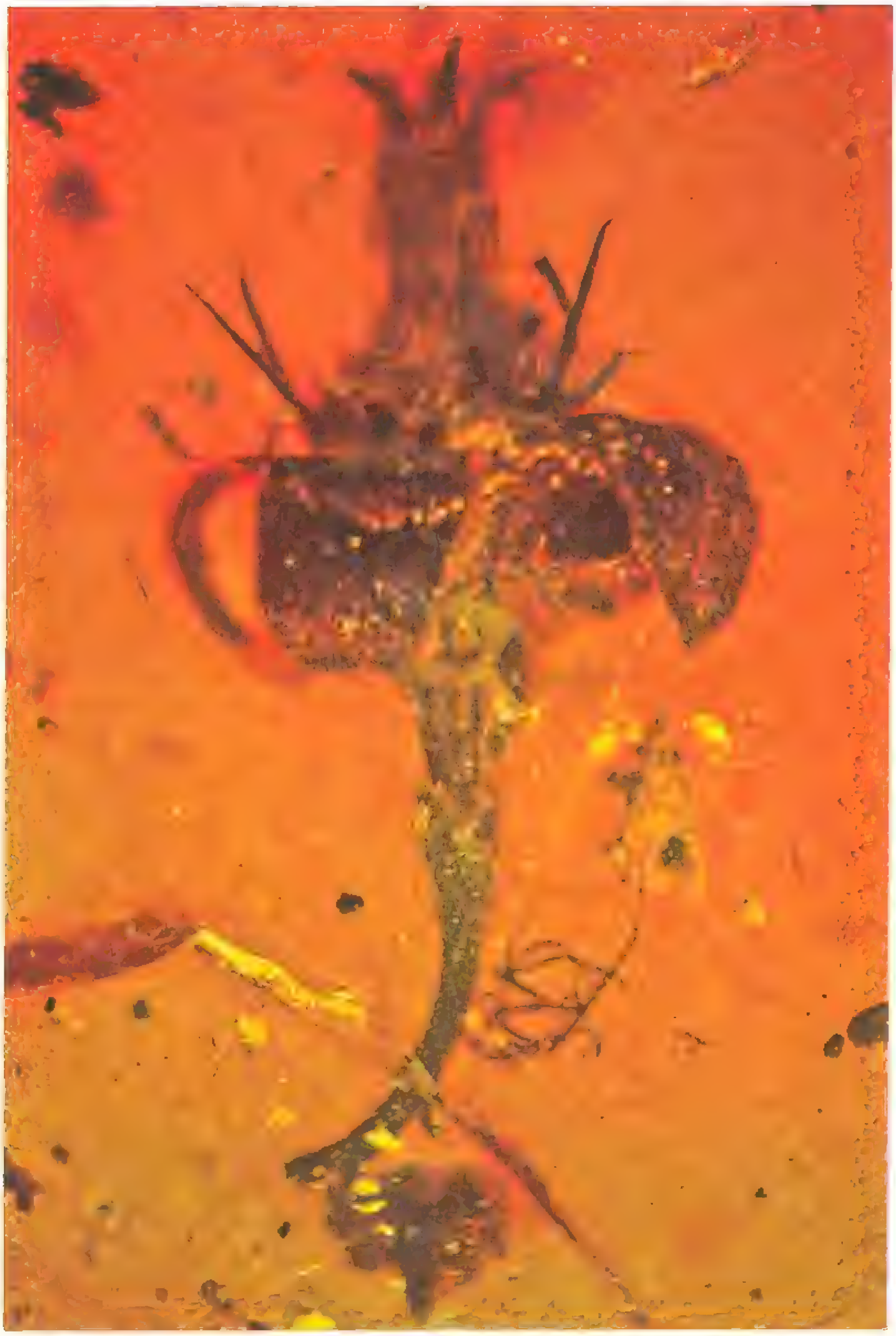
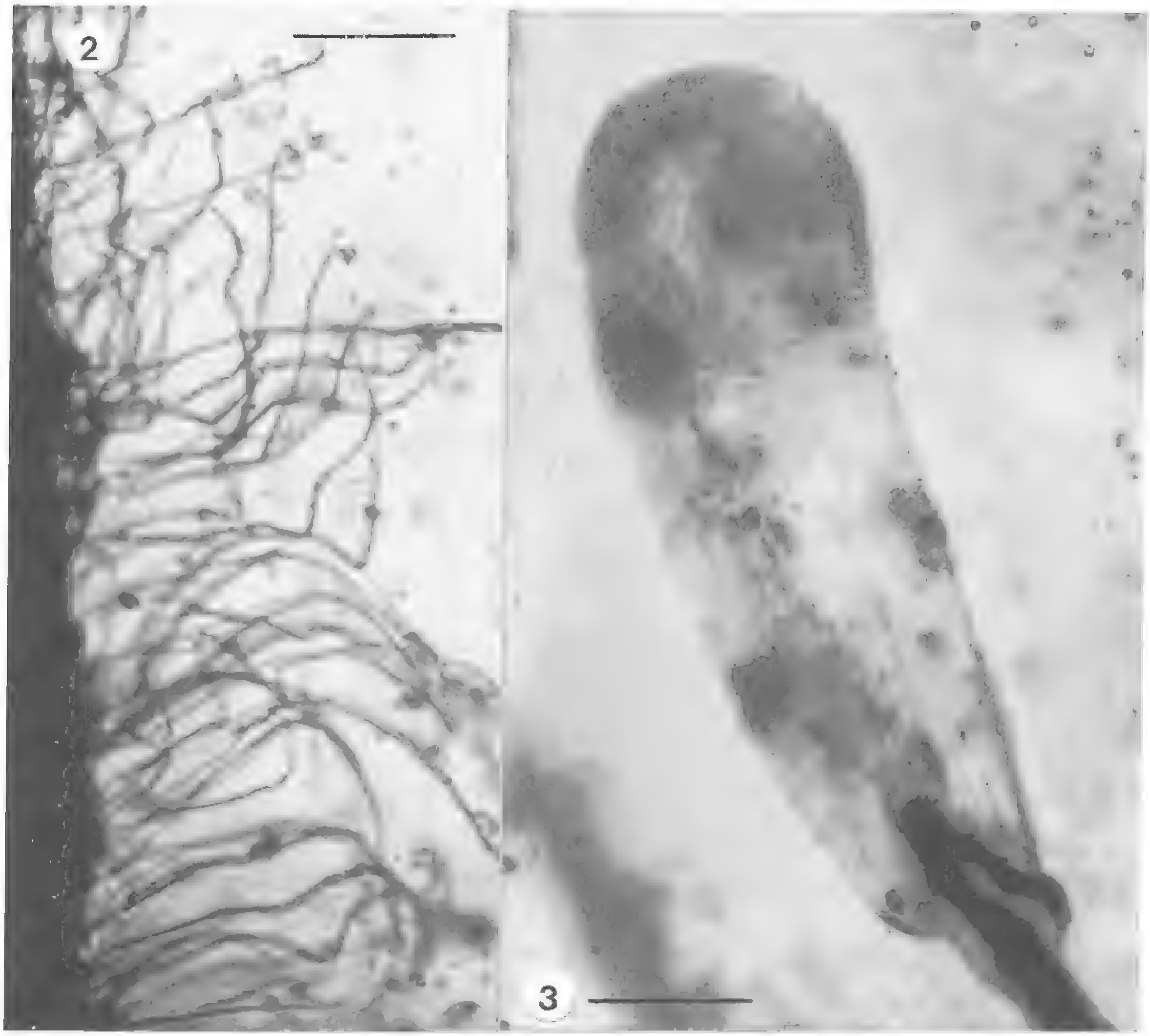


Fig. 1. Flower of *Lachnociona terriae* in Burmese amber. Holotype specimen. Scale bar = 1.43 mm.

Acsmithia, the latter two genera comprising a possible morphological link with Brunelliaceae (Orozco Pardo 2002; but see Bradford & Barnes, 2001, for DNA evidence supporting their inclusion in Cunoniaceae). Genera of Cunoniaceae with unisexual flowers include *Spiraeanthemum*, *Pancheria*, and *Vesselowskya*, and the latter genus is unique in the family in showing a ventrally decurrent stigma like that of *Brunellia* (Dickison 1989, fig. 4.3; Hufford & Dickison 1992) and putatively like that of *Lachnociona*. That the ovary of the fossil might be half or more inferior (judging from the expanded apex of the floral pedicel) was mentioned above; in this, it would resemble *Schizomeria* (Matthews & Endress 2002) and *Pullea* (Dickison 1975) and differ from *Spiraeanthemum* and *Vesselowskya*. The styles may be erect and partially connivent in some Cunoniaceae (at



Figs. 2–3. Flower of *Lachnociona terriae* in Burmese amber. 2. Long trichomes on surface of sepals. Scale bar = 126 μm. 3. Transparent vestigial anther. Note reflexed tip of filament. Scale bar = 123 μm.

least in early flower), as illustrated for *Pullea* and *Acsmithia* by Dickison (1975, fig. 15h, and 1989, fig. 4.2B, respectively) and Hoogland (1979, fig. 1). Of the above-mentioned genera, petals are absent in *Brunellia, Spiraeanthemum, Acsmithia, Pullea*, and (in pistillate flowers) *Vesselowskya* (Dickison 1989). None of the modern genera listed have styles pubescent nearly to the tip like *Lachnociona*.

Aphanopetalum (Aphanopetalaceae) is included in Table 1; it has a 4-carpelled gynoecium with half-inferior ovary, and a stout stylar column with spreading, terminally-stigmatic tips (Dickison 1975, fig. 1a). Dickison (op. cit.) shows a median longitudinal section of a flower nearing anthesis; its thick style of 4 fused carpels with spreading, bluntly pointed tips very much resembles the stout (but more acutely tipped) gynoecium of *Lachnociona*. Significant differences are evident, however, in the androecium of 8 large, fertile, nearly sessile anthers of *Aphanopetalum*, the 4-merous calyx, and the presence of 4 poorly developed petals. The flowers of *Aphanopetalum* are glabrous, as well. This genus has an interesting taxonomic history, having been placed originally in Cunoniaceae (Engler 1930b; Dickison 1975; Hufford & Dickison 1992), but it was found by Bradford and Barnes (2001) to be better placed in or near Saxifragaceae, according to their analysis of the *TrnL-F* intron of the chloroplast tRNA-Leu gene. Based on the morphological work of

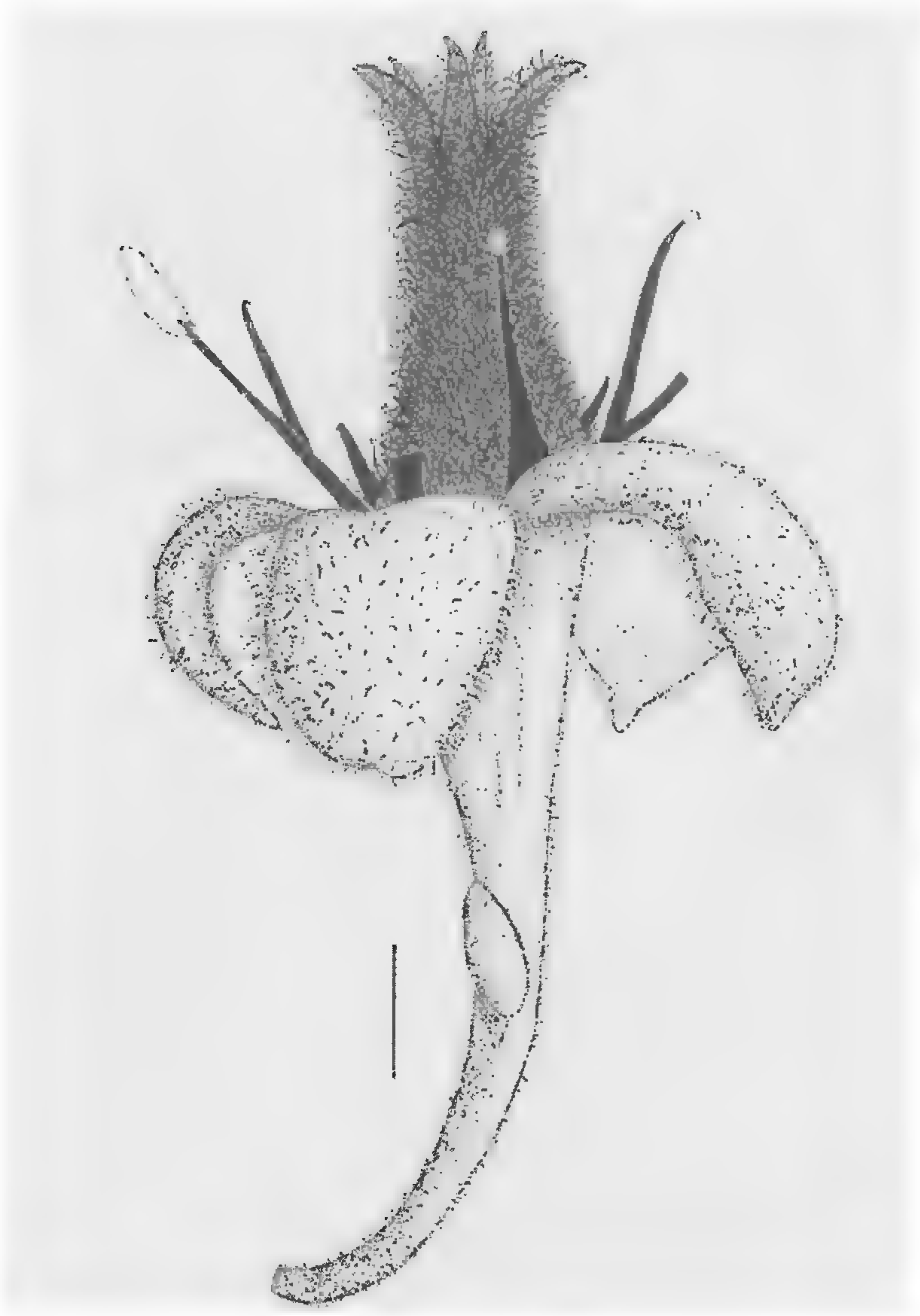


Fig. 4. Drawing of flower of *Lachnociona terriae* in Burmese amber. Scale bar = 1 mm.

Dickison et al. (1994) and the molecular phylogenetic studies by Fishbein et al. (2001) and Hermsen et al. (2006), *Aphanopetalum* is now placed as a monotypic family of the order Saxifragales (Stevens 2001 onwards; Soltis et al. 2005).

Platydiscus is a well-studied charcoalified Late Cretaceous fossil flower from sand and clay sediments of the Kristianstad Basin in Scandia, Sweden (Schönenberger et al. 2001, see drawing of a reconstruction in Friis et al. 2006). The perianth is 4-merous, with small, densely glandular petals and spreading sepals, stamens are 8 and fertile, and the gynoecium of 4 carpels has a half-inferior ovary and connivent, erect styles. The spreading stylar tips are reconstructed as acute with a ventral slit; the stigmatic region is not described but may well have followed the slit as, e.g., in *Brunellia* and *Vesselowskya* (our suggestion, not the authors'). The connivent styles, with broken off tips, are well illustrated by Schönenberger et al. (2001, figs 34 and 40). Features of the gynoecium of this fossil, as illustrated and reconstructed, are thus quite reminiscent of *Lachnociona* as we visualize it. Differences between our fossil and *Platydiscus* are that the latter is 4-merous throughout, bisexual, and petaliferous. Its age, given as Late Santonian–Early Campanian, is approximately 20 my younger than that of the fossil reported here from the Early Cretaceous.

The possible phylogenetic relationship of *Platydiscus* to Cunoniaceae and Anisophylleaceae, and that of the latter two groups to each other, was discussed by Matthews et al. (2001), who pointed out the anomalous position of the latter family in the order Cucurbitales (see also Tobe & Raven 1988). However, this ordinal assignment is well borne out by recent molecular studies (Schwarzbach & Ricklefs 2000; Zhang et al. 2006).

The flowers of *Anisophyllea* are similar in many ways to those of Cunoniaceae and *Platydiscus*, as cited in detail by Matthews et al. (2001). Like *Lachnociona*, *Anisophyllea* is unisexual, with two whorls of stamens, separate acute styles, and stigmas decurrent ventrally (Matthews et al. 2001; Matthews & Endress 2004). It differs in being petaliferous and usually 4-merous throughout, and its ovary is fully inferior (Table 1). These and numerous other traits of Anisophylleaceae are discussed by Matthews and Endress (2004), giving support to its placement in Cucurbitales despite its divergence in floral form from other families of the order.

An alternative interpretation of the perianth of *Lachnociona*, namely that the conspicuous organs are petals and that an inconspicuous calyx is out of sight beneath them, leads to comparison with a different rosid group, the family Simaroubaceae of order Sapindales. We have selected the Southeast Asian genus *Eurycoma* (Engler 1931, fig. 175; Nooteboom 1962, p. 206) for such a comparison (Table 1). In *Eurycoma*, the conspicuously hairy flowers are unisexual, the 5-lobed superior ovary of 5 free carpels bearing 5 erect, connate or connivent styles which are acute, recurved at the tip, and stigmatic ventrally. In fruit, the 5 carpels separate and spread far apart, as occurs also in *Brunellia*. The androecium of pistillate flowers consists of 5 normal-sized stamens with abortive anthers, alternating with 5 scale-like, much modified staminodes. The 5 hairy petals are spreading-erect and have 5 small sepals at their base. Other than stamen number, therefore, and reflexed rather than erect petals, *Lachnociona* would resemble *Eurycoma*—if we hypothesize that a small calyx is hidden below the "petals." The fossil thus bears an ambiguous relationship to Simaroubaceae, which we cannot resolve with certainty. In phylogenetic analyses, Simaroubaceae, sensu stricto, are placed in the rosid II clade (Fernando et al. 1996; Gadek et al. 1996; APG II 2003; Stevens 2001 onwards; Soltis et al. 2005; Schönenberger & von Balthazar 2006).

In summary, the case for postulating a relationship of *Lachnociona* to the clade containing Brunelliaceae and Cunoniaceae rests on the similarity of the following critical floral features: unisexuality, 5-merous actinomorphic perianth, apetaly, abundant pubescence, presence of 10 staminodes in the pistillate flower, 5 carpels, a stout gynoecial column (which may be) comprised of 5 connivent styles, and sharply acute stylar tips implying a ventrally decurrent stigmatic zone. A superior ovary or ovaries, if present, would be consistent with these families, but if the ovary is interpreted as half-inferior, a similarity would exist to *Pullea* and a few other Cunoniaceae (*Bauera*, f. Dickison, 1975; *Ceratopetalum*, f. Engler, 1930b; *Codia*, f. Hufford & Dickison, 1992) as well as to *Aphanopetalum* and the completely epigynous *Anisophyllea*. A decurrent "sutural" stigma is characteristic of *Brunellia* (Kubitzki 2004) and *Vesselowskya* of Cunoniaceae (Dickison 1989; Hufford & Dickison 1992).

Our suggestion of a connection with Brunelliaceae and Cunoniaceae cannot be proven, given the difficulty in observing certain critical features of the gynoecium of *Lachnociona*. However, we believe that the totality of floral features favors placement of the fossil in the rosid clade of eudicots (e.g., Fernando et al. 1995; Soltis & Soltis 2004; Soltis et al. 2005; Schönenberger & von Balthazar 2006). Except for Saxifragales, the four orders from which we have selected comparative examples are in this large group of angiosperms. According to Friis et al. (2006, p. 7), "(t)he presence of distinctive tricolpate pollen grains in Late Barremian-Early Aptian strata (about 120 Myr) shows that eudicot angiosperms were established in geographically widespread regions early in the history of angiosperms." Estimates for the ages of crown and stem groups of basal eudicots were presented by Anderson et al. (2005) using *rbcL* sequences and multiple fossil reference points. Their inferred stem and crown group ages for rosids are 112 mybp and 108 mybp, respectively, and for Saxifragales, the figures are 108 mybp and 102 mybp. In a different analysis, Crepet et al. (2004) dated the minimum age of the "rosid I" clade as 94+ mybp. Both these estimates are younger than that of Wilkström et al. (2001), which dates the stem group of the rosids at 125 mybp. As pointed out by Friis et al. (2006, p. 31), "(a) rapid diversification of eudicots, with the emergence of all lineages of basal eudicots before the end of the Albian, has....been inferred, using molecular dating methods." In this context, the eudicot flowers that have recently been described from Burmese amber of the Late Albian (Poinar 2004; Poinar & Chambers 2005; Poinar et al. 2007), together with the present report, may help open a window to particular features of floral evolution in this period of eudicot diversification.

The flower described here may have been insect-pollinated, as proposed earlier by Santiago-Blay et al. (2005), and it could have been visited by *Melittosphex burmensis*, a small bee recently described from these deposits (Poinar & Danforth 2006). The flower also shows evidence of herbivory, as there is obvious damage to the filaments and anthers by chewing insects.

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A PHYLOGENY OF *BEJARIA* (ERICACEAE: ERICOIDEAE) BASED ON MOLECULAR DATA

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ABSTRACT

Phylogenetic relationships of ten of the fifteen recognized species of *Bejaria* were examined using molecular (*ndh*F 5', *mat*K; chloroplast and *waxy*; nuclear) data. Parsimony analyses were performed in PAUP for each gene, combined chloroplast data and total combined data. Bayesian analyses were performed in MrBayes for the *waxy*, combined chloroplast and total combined data sets. Bejarieae (*Bejaria, Bryanthus* and *Ledothamnus*) is not monophyletic in any analysis. The sampled members of *Bejaria* are monophyletic in all analyses with strong support. *Bejaria racemosa*, the only species from North America, is strongly supported as sister to all other *Bejaria* members.

RESUMEN

Las relaciones filogenéticas de 10 de las 15 especies reconocidas de *Bejaria* fueron examinadas utilizando datos moleculares (*ndhF* 5', *matK*, y *waxy*). Los análisis de parsimonia fueron realizados en PAUP para cada gen, para los datos de cloroplasto y para los datos combinados totales. Los análisis Bayesianos se realizaron en MrBayes para el gen nuclear *waxy*, los datos de cloroplasto y para los datos combinados totales. En nuestro análisis la tribu Bejarieae (*Bejaria, Bryanthus* y *Ledothamnus*) no es monofilética. En todos los análisis, los miembros muestreados de *Bejaria*, son monofiléticos con un soporte alto. *Bejaria racemosa*, la única especie de Norte América, fue resuelta como hermana de los otros miembros de *Bejaria*.

Bejaria Mutis ex. L. (Ericoideae: Ericaceae) contains fifteen species distributed in South America, Central America and the Caribbean with *B. racemosa* occurring in the southeast United States (Clemants 1995). The Ericaceae typically have a corolla that is fused basally and a five-merous corolla; therefore *Bejaria* was thought to be the most ancestral within the family due to its free petals and higher merosity (Stevens 2007; Camp 1941). This idea is not supported in recent studies (e.g., Kron et al. 2002) that show *Enkianthus* Lour. (Enkianthoideae) as sister to all other taxa in the Ericaceae. Among the eight recognized subfamilies in Ericaceae the Ericoideae clade contains five named groups (tribes): Bejarieae, Empetreae, Ericeae, Phyllodoceae and Rhodoreae. Relationships among these five tribes are unresolved (Kron et al. 2002). *Bejaria, Bryanthus* S.G. Gmel. and *Ledothamnus* Meisn. comprise Bejarieae (Kron et al. 2002). *Ledothamnus* is a genus of nine species occurring in the Guyana Highlands and *Bryanthus* is monotypic, found only in Kamtchatka and Japan (Mabberley 1997).

The most recent taxonomic revision of *Bejaria* was based on morphological characters and there are two sections in the genus: sect. *Racemosae* and *Bejaria* (Clemants 1995). Fourteen of the species are in sect. *Bejaria*, while *B. racemosa* is the only member of sect. *Racemosae*, unique in its chartaceous leaves, the "stalked" appearance of its inflorescence (i.e., there is a relatively long area at the base of the raceme that does not contain leaves or flowers) and numerous distinct leaf anatomy characteristics (Clemants 1995).

After being discovered in 1767 in Colombia by Jose Celestino Mutis, *Bejaria* has been taxonomically revised three times in its entirety (Fedtschenko & Basilevskaja 1928; Mansfeld & Sleumer 1935; Clemants 1995). Fedtschenko and Basilevskaja (1928) focused their revision on the characteristics of pubescence and also inflorescence type. Mansfeld and Sleumer (1935) based their revision on plant indumentum and corolla size. Finally, Clemants (1995) based his monograph of the genus primarily on corolla shape, as opposed to the traditional use of indumentum and inflorescence characters.

Four species of *Bejaria*—*B. aestuans*, *B. resinosa*, *B. sprucei*, and *B. mathewsii*—are widespread in distribution, particularly *B. aestuans* which is found from Mexico to Bolivia (Clemants 1995). The other eleven

J. Bot. Res. Inst. Texas 2(2): 1193 – 1205. 2008

species are considered to be endemic and several are in need of conservation due to habitat destruction and spreading human habitation (Clemants 1995).

Bejaria is typically diagnosed by a combination of morphological features such as its seven-merous flowers, free petals, capsular fruits, non-appendaged anthers, and viscin threads among the pollen tetrads (Clemants 1995). Individually, many of these characteristics are shared with other members of Ericaceae (Stevens 1971). The only known potential morphological synapomorphy for the genus is tetracytic stomata (Stevens 1971).

An unusual characteristic of *Bejaria* is the presence of tubular corollas despite the fact that all species have separate petals (Clemants 1995). There are four recognized corolla shapes among the 15 species of *Bejaria* (Clemants 1995). The majority of species have campanulate and/or spreading corollas (*B. aestuans, B. cubensis, B. imthurnii, B. neblinensis, B. racemosa, B. steyermarkii, B. subsessilis*; Clemants 1995). Several other species exhibit tubular corollas (*B. ledifolia, B. mathewsii, B. resinosa, B. sprucei* and *B. zamorae*; Clemants 1995). Two species (*B. nana* and *B. tachirensis*) have small globose corollas (Clemants 1995). Finally, *B. infundibula* has a funnel-shaped corolla (Clemants 1995).

The variation seen in corolla shape within *Bejaria* may reflect different pollination modes and serve as reproductive isolating mechanisms for the separate species, but very little is actually known about the pollinators of the genus (Clemants 1995). For example, *B. resinosa* predominantly self-pollinates and only occasionally outcrosses (Kraemer 2001). When a biotic pollinator is involved, however, the long, tubular corollas of *B. resinosa* were thought to be pollinated by long-billed hummingbirds (Kraemer 2001). In a pollination study by Kraemer (2001), *B. resinosa* was visited more often by bumble bees (*Bombus funebris*). Bumble bees may pollinate *B. resinosa* more frequently than hummingbirds, but the birds may play an occasional, but significant role in long distance dispersal of pollen for the species (Kraemer 2001). In the study, short-billed hummingbirds were common but visited the flowers rarely, most likely due to the inaccessibility of nectar in the long tube (Kraemer 2001). Nectar robbers (flowerpiercers; *Diglossa humeralis*) were also a common visitor to these flowers but did not assist in pollination (Melampy 1987; Kraemer 2001). Out of the 15 species of hummingbirds at the site, only two were long-billed and both occurred infrequently in the area (Kraemer 2001). These data appear to suggest that hummingbird pollination is indeed rare for the long-tubed *B. resinosa* (Kraemer 2001).

Corollas that are spreading or campanulate are also visited by bees (Clemants 1995). For instance, *B. racemosa* (spreading or rotate corolla shape), from the southeastern United States, was visited by the common honey bee *Apis melifera* (Clemants 1995). *Bejaria aestuans*, with a campanulate corolla, was visited by bees (Clemants 1995). No documentation for the successful pollination of these species by the visitors is available. Pollinators for the infundibular or globose corolla types are not known.

Ethnobotanically, species within the genus have been used on both continents independently as "fly paper" due to the thick resin secreted from glandular hairs on both the flowers and leaves (Clemants 1995). It has been shown that the resin on *B. racemosa* flowers is as strong as commercially produced fly adhesive (Eisner & Aneshansley 1983). Species of *Bejaria* have also been used for woodworking, medicinal purposes, and until late in the 19th century as a popular ornamental (Clemants 1995).

There has never been a published cladistic analysis of *Bejaria*. The goals of this study were to address: (1.) the monophyly of Bejarieae and *Bejaria* using molecular data (2.) the relationships within the genus; particularly the relationship of *B. racemosa* to all other sampled species.

MATERIALS AND METHODS

Taxon sampling

Ten species (of the 15 recognized by Clemants 1995) of *Bejaria* were included in the molecular study. *Bejaria cubensis, B. nana, B. steyermarkii* and *B. tachirensis* were excluded because the chosen gene regions could not be successfully amplified from available material. *Bejaria neblinensis* is known only from the type locality (Cerro de la Neblina, Venezuela) and the very few specimens of this species were not available for loan or for DNA extraction.

For all analyses, 13 species representing other clades within Ericoideae were included (Table 1). In the chloroplast analyses (*ndhF*, *matK* and combined chloroplast analyses) ten species of *Bejaria* were included in the ingroup. For all analyses containing the nuclear *waxy* data set (*waxy* and total combined data analyses), *B. infundibula*, *B. mathewsii* and *B. sprucei* were excluded from the ingroup due to large amounts of missing data. Representative Ericoideae taxa were chosen based on previous work within the Ericaceae (Kron et al. 2002). All analyses were rooted with *Cassiope mertensiana*. *Cassiope* D. Don (Cassiopoideae) was found in previous analyses to be sister to the Ericoideae (Kron et al. 2002). Voucher information for the molecular study is presented in Table 1.

DNA extraction, amplification, and sequencing

Plant material originally dried for flavonoid analysis in 1983 was provided by Steven Clemants (Brooklyn Botanic Gardens). These leaves were air-dried and no other means of preservation was used (i.e., silica gel, refrigeration; S. Clemants, pers. comm.). DNA was extracted from these ~20 year old leaves and other material using an Epicentre Leaf Extraction kit (Epicentre Technologies, Madison, Wisconsin, U.S.A.) or by using the CTAB protocol of Doyle and Doyle (1987). Less degraded DNA was obtained from the "air"-dried leaves compared to similarly aged herbarium sheets. All extractions were cleaned with a Qiagen cleanup kit (Qiagen Sample and Assay Technologies, Valencia, California, U.S.A).

Two chloroplast genes, *ndh*F and *mat*K, were amplified using standard polymerase chain reaction (PCR) protocols and previously published primers (Olmstead et al. 1993; Steel & Vilgalys 1994). The *ndh*F gene encodes a subunit of the nicotinamide dehydrogenase complex and is ca. 2223 base pairs long (Olmstead & Sweere 1994; Alverson et al. 1999). The dehydrogenase complex functions in direct hydrogen transfer between the substrate and the nicotinamide ring (Cook & Cleland 1981). The *mat*K gene encodes a ribosomal maturase and it is located in the intron of *trn*K, a gene that encodes the transfer RNA for lysine (Johnson & Soltis 1994). The *mat*K gene is approximately 1500 base pairs long (Johnson & Soltis 1994). The nuclear gene included in this study is *waxy*, which encodes the granule-bound starch synthase (GBSSI; Miller et al. 1999). This gene has 13 translated exons and is approximately 4500 base pairs long (Peralta & Spooner 2001). The gene functions in the synthesis of amylose (Mason-Gamer et al. 1998). For this study, the region between exons 9 and 11 was amplified for a total of 628 base pairs (Miller et al. 1999; Peralta & Spooner 2001). *Bejaria aestuans, B. imthurnii, B. racemosa* and *B. resinosa* were cloned for the *waxy* gene and because no multiple copies were found the remainder of the species were not cloned. All PCR products were gel isolated and cleaned using Qiagen gel isolation kits (Qiagen Sample and Assay Technologies, Valencia, California, U.S.A). Sequencing was performed on an ABI 3700 machine located at the DNA sequencing facility of Wake Forest University. All sequences were edited using Sequencher 3.1.1 (Gene Codes Corporation, Ann Arbor, MI) and were aligned manually. GenBank accession numbers are listed in Table 1.

Phylogenetic analyses

Parsimony analyses were performed in PAUP* 4.0b2 (Swofford 1999). Characters were unordered and gaps within the molecular data were treated as missing data. All characters were equally-weighted and only those that were parsimony informative were included in the analyses. For *ndhF*, only the 5' end of the gene was used due to extensive missing data in several taxa in the 3' end. The total number of base pairs for the *ndhF* 5' gene region is 1318. The three gene regions (*ndh*F, *mat*K, and *waxy*) were analyzed separately using the heuristic search option with 1000 replicates, TBR branch swapping, and random step-wise addition. Bootstrap analyses were used to estimate clade support and bootstrap scores (bt) were recorded (1000 replicates of TBR branch swapping with 100 replicates in the heuristic search; Felsenstein 1985). Conflict between trees was assessed by inspecting the results from different analyses for medium to high bootstrap scores (greater than 80%) that supported different relationships between the taxa. There was no strongly supported conflict between the two chloroplast genes and the *waxy* gene region so all data were combined for a total evidence analysis.

For the Bayesian analyses, each individual gene set was run in ModelTest 3.7 (Posada & Crandall 1998) to determine the best substitution type (Nst) and rate distribution model (rates) for each gene region.

Table 1. *Bejaria* and other species in the Tribe Bejarieae sampled, sources of material, vouchers, and GenBank accession numbers for molecular analyses.

Taxon	Voucher	ndhF	matK	waxy
Bejaria aestuans Mutis ex. L.	Luteyn 14175 (NY)	DQ002362	DQ002346	DQ000589
Bejaria imthurnii N.E. Br.	Clemants & Delascio 2453b (NY)	DQ002363	DQ002347	DQ000590
Bejaria infundibula Clemants	Clemants & Fernandez 2007c (NY)	DQ002364	DQ002348	N/A
Bejaria ledifolia Bonpl.	Clemants 2483b (NY)	DQ002365	DQ002349	DQ000592
Bejaria mathewsii Fielding & Gardner	Clemants 2046 (NY)	DQ002366	DQ002350	N/A
Bejaria racemosa Vent.	Kron 2070 (NCU)	DQ002367	DQ002351	DQ000594
Bejaria resinosa Mutis ex. L.	Luteyn 14133 (NY)	DQ002368	DQ002352	DQ000595
Bejaria sprucei Meisn.	Clemants & Delascio 2479 (NY)	DQ002369	DQ002353	N/A
Bejaria subsessilis Benth.	Clemants 2278a (NY)	DQ002370	DQ002354	DQ000596
Bejaria zamorae Clemants	Bush 212 (LOJA)	DQ002371	DQ002355	DQ000597
Bryanthus gmelinii D. Don	Stevens DNA 192 (WFU)	EU669881	AF440413	EU669884
Cassiope mertensiana (Bong.) G. Don	s.n. (AA 75-83)	DQ002372	U61346	DQ000598
Ceratiola ericoides (Michx.)	Kron 2069 (WFU)	DQ002373	U61334	DQ000599
Elliottia bracteata (Maxim.) Hook. f.	s.n. (RBGK 1979-5019)	DQ002374	U61339	DQ000600
Empetrum atropurpureum Fernald & Wiegand	s.n. (RBGK 1988-433)	DQ002375	U61355	DQ000601
Kalmia angustifolia L.	Kron DNA156 (WFU)	DQ002376	DQ002356	DQ000602
Kalmiopsis leachiana (Henderson) Rehder	Kron DNA177 (WFU)	DQ002377	U61323	DQ000603
Ledothamnus guyanensis Meisn.	Picon & Williams 2910 (NY)	EU669882	AF440419	EU669885
Phyllodoce caerulea Bab.	s.n. (RBGK 1940-1013)	DQ002378	DQ002357	DQ000604
Phyllodoce empetriformis D. Don	s.n. (RBGK 1978-2120)	DQ002379	DQ002358	DQ000605
Rhododendron grande Wight	s.n. (RBGK 1969-8606)	DQ002383	DQ002360	EU669886
Rhododendron hippophaeoides Balf.f. & W.W. Sm.	s.n. (RBGK 1932-1022)	EU669883	U61353	EU669887
Rhodothamnus chamaedistus Rchb.	s.n. (RBGK 1989-459)	DQ002381	U61321	DQ000607

Three separate analyses were performed in MrBayes v.3.1.2 (Ronquist & Huelsenbeck 2003): *waxy*, combined chloroplast and total combined data. The individual *ndhF* and *matK* analyses were not performed using Bayesian because the results from each were predominantly unresolved in the parsimony analysis and the combined chloroplast tree represents both data sets. For the multiple gene analyses, the genes were partitioned in MrBayes and the appropriate models were applied for each gene region. Each analysis ran for 1,000,000 generations and was sampled every 100 generations. The burn-in period was the first 2,500 sampled generations. The model used for each gene region is as follows: *ndhF*: HKY+G; *matK*: TVM+G and *waxy*: HKY+G. Posterior probability values ($_p$P) were calculated in MrBayes.

RESULTS

Analysis of chloroplast sequences

The aligned *ndhF* data set for 23 taxa was 1318 base pairs long. For this parsimony analysis, 1719 most parsimonious trees were found (L = 531; C.I. = 0.59; R.I. = 0.72; data not shown). There were 217 informative characters (16.5 %). The aligned *mat*K data was comprised of 1541 characters and included the same taxa as in the *ndhF* analysis. In the *matK* analysis, 198 most parsimonious trees were recovered (L = 470; C.I. = 0.63; R.I. = 0.78; data not shown) and 216 characters were informative (14.0 %). Results of the separate *ndhF* and *matK* parsimony analyses were similar in support and topology to the combined chloroplast analysis so only the results of the latter will be discussed.

The combined chloroplast parsimony analysis resulted in 431 informative characters (2859 included base pairs) and 9 most parsimonious trees (L = 1012; C.I. = 0.60; R.I. = 0.74). *Bejaria* is found to be monophyletic in this analysis (100% bt; Fig. 1). *Bejaria infundibula* is sister to *B. mathewsii* (91% bt) and this clade is in a polytomy with *B. imthurnii* and *B. subsessilis* (73% bt; Fig. 1). The four taxa in this clade are placed in a trichotomy with *Bejaria aestuans* and *B. zamorae* (62% bt; Fig. 1). Sister to this clade is *B. resinosa* (100% bt), followed by *B. sprucei* (65% bt) and *B. ledifolia* (50% bt; Fig. 1). Finally, *B. racemosa* is sister to all other *Bejaria* members sampled (Fig. 1). Outgroup relationships based on this analysis show Clade A (Phyllodoceae, Kron et al. 2002) as sister to *Bejaria*, but without support (Fig. 1). Clade B (Empetreae + Rhodoreae, Kron et al. 2002) is placed sister to Clade A + *Bejaria* and Clade C is sister to the remaining sampled taxa (Fig. 1).

A monophyletic *Bejaria* was also recovered in the Bayesian combined chloroplast analysis (100% $_{\mathrm{P}}$P; Fig. 2). In this phylogeny, *B. imthurnii* and *B. subsessilis* are sister to each other (52% $_{\mathrm{P}}$P) as are *B. infundibula* and *B. mathewsii* (100% $_{\mathrm{P}}$P) and the two clades are sister to each other (97% $_{\mathrm{P}}$P; Fig. 2). *Bejaria aestuans* and *B. zamorae* are in a polytomy with the previous clade (88% $_{\mathrm{P}}$P; Fig. 2). Sister to this larger clade is *B. resinosa* (100% $_{\mathrm{P}}$P; Fig. 2). *Bejaria ledifolia* and *B. sprucei* are unresolved with respect to this clade (100% $_{\mathrm{P}}$P; Fig. 2). Finally, *B. racemosa* is sister to all other *Bejaria* sampled (100% $_{\mathrm{P}}$P; Fig. 2). The relationship of Clade A to *Bejaria* is the same in this analysis as in the parsimony results (Figs. 1, 2). However in this analysis Clade B is sister to Clade C, although with low posterior probability (Fig. 2).

Analysis of waxy (nuclear) sequences

The aligned portion of *waxy* for 20 included taxa was 628 bases long (region between exons 9–11). The parsimony analysis resulted in 450 trees with a length of 175 (C.I. = 0.71; R.I. = 0.83). There were 93 informative characters in this analysis (14.8%). This analysis also supported a monophyletic *Bejaria* (100% bt, Fig. 3). It places *B. aestuans*, *B. imthurnii*, *B. ledifolia*, *B. resinosa*, *B. subsessilis*, and *B. zamorae* in a polytomy (94% bt) with *B. racemosa* sister to this clade (100% bt; Fig. 3).

In the Bayesian analysis of the *waxy* data, *Bejaria* is monophyletic (100% $_{\mathrm{P}}$P; Fig. 4) but there is very little resolution within the genus. *Bejaria racemosa* is sister to all other *Bejaria* members, which are in a polytomy (99% $_{\mathrm{P}}$P; Fig. 4). *Ledothamnus guyanensis* is sister to *Bejaria* (89% $_{\mathrm{P}}$P; Fig. 4). Although placement of the outgroup taxa varies between parsimony and Bayesian analyses neither of these results are strongly supported.

Analysis of combined nuclear and chloroplast sequences:

The combined data set was 3487 aligned bases long. There were 513 informative characters (14.7%). The parsimony analysis produced 6 trees 1142 steps long (C.I. = 0.62; R.I. = 0.73). In this combined analysis, *Bejaria* is monophyletic with 100% bootstrap support (Fig. 5). *Bejaria imthurnii* and *B. subsessilis* are sister clades (95% bt) inside a polytomy including *B. aestuans* and *B. zamorae* (89% bt; Fig. 5). Sister to this polytomy is *B. resinosa* (100% bt; Fig. 5) and sister to this larger group is *B. ledifolia* (85% bt; Fig. 5). Finally, *B. racemosa* is sister to the remaining taxa sampled (Fig. 5). Among the outgroup taxa Clades B and C are placed as sister with very low support (56% bt) and sister to this clade is Clade A (Fig. 5).

In the Bayesian analysis of all combined data, *Bejaria* is monophyletic (100% $_{\mathrm{P}}$P; Fig. 6). The clade *B. imthurnii* + *B. subsessilis* (100% $_{\mathrm{P}}$P) is in a polytomy with *B. aestuans* and *B. zamorae* (100% $_{\mathrm{P}}$P; Fig. 6). Sister to this clade is *B. resinosa* (100% $_{\mathrm{P}}$P) followed by *B. ledifolia* (100% $_{\mathrm{P}}$P; Fig. 6). Finally, *B. racemosa* is sister to all other *Bejaria* members sampled (Fig. 6). Similar to the parsimony analysis Clades B and C are placed as more closely related to each other than to Clade A (Figs. 5, 6). However, the Bayesian analysis places Clade A sister to *Bejaria* (Fig. 6).

DISCUSSION

Both parsimony and Bayesian total evidence analyses show *Bejaria* as monophyletic and *B. racemosa* as sister to the remaining *Bejaria* sampled. Deeper nodes of the tree prevent conclusions about the closest relatives to *Bejaria* as can be seen by the difference in placement of Clade A as sister to *Bejaria* in the Bayesian results (Fig. 6) or as (Clade A (Clade B + Clade C)) in the parsimony results (Fig. 5). Clade C contains two members of the Bejarieae as recognized by Kron et al., (2002). In their study they circumscribe Bejarieae

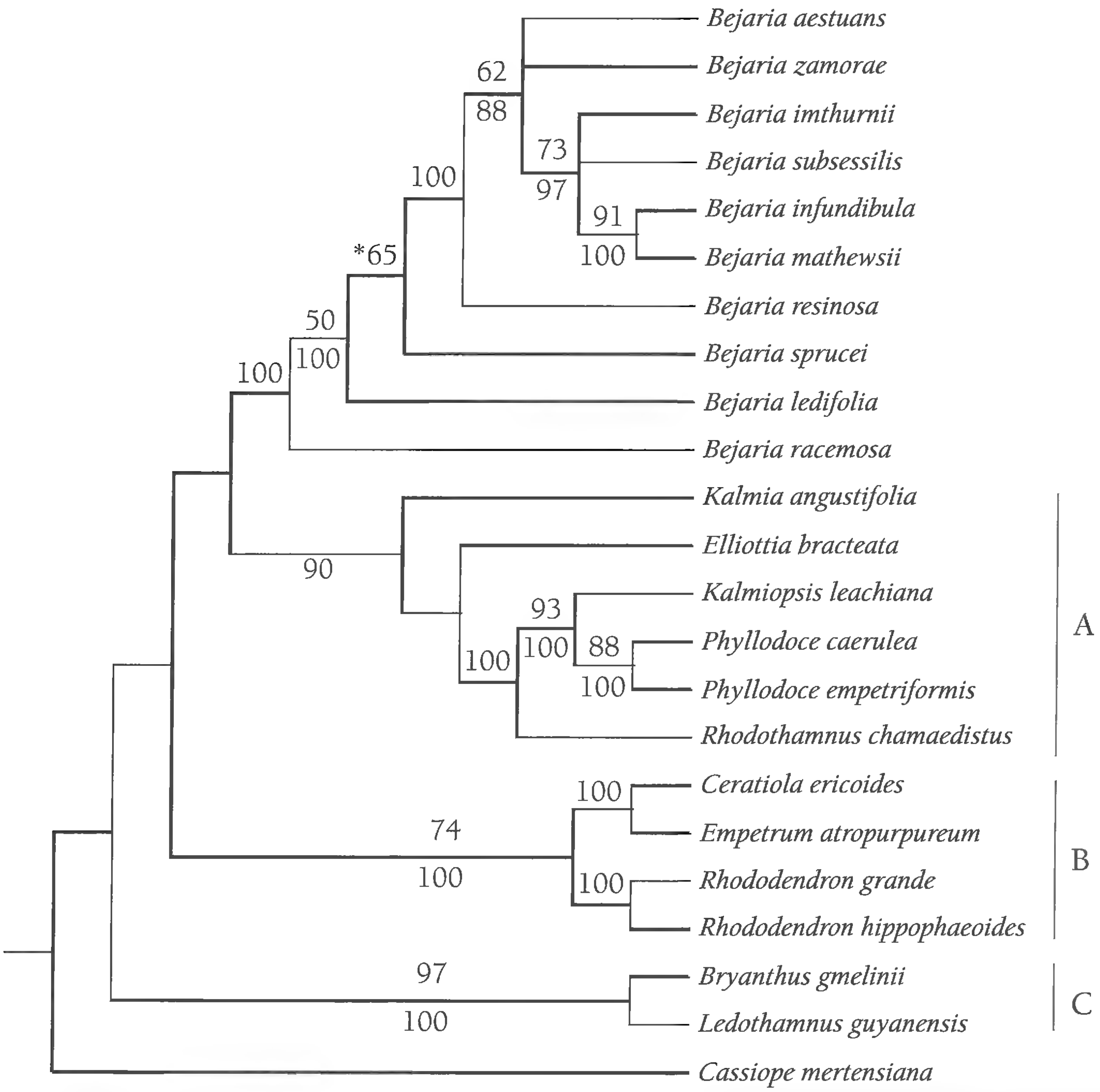
Bejaria aestuans
Bejaria zamorae
Bejaria imthurnii
Bejaria subsessilis
Bejaria infundibula
Bejaria mathewsii
Bejaria resinosa
Bejaria sprucei
Bejaria ledifolia
Bejaria racemosa
Kalmia angustifolia
Elliottia bracteata
Kalmiopsis leachiana
Phyllodoce caerulea
Phyllodoce empetriformis
Rhodothamnus chamaedistus
Ceratiola ericoides
Empetrum atropurpureum
Rhododendron grande
Rhododendron hippophaeoides
Bryanthus gmelinii
Ledothamnus guyanensis
Cassiope mertensiana
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Fig. 1. Strict consensus of 9 most parsimonious trees (L = 1012, CI = 0.60, RI = 0.74) obtained in the analysis of the combined chloroplast genes (5′*ndhF* and *matK*). When two numbers on a branch are present, numbers above the branches represent bootstrap values greater than 50% and numbers below the branches indicate posterior probabilities. An asterisk next to a value indicates that the node is not present in the other analysis (parsimony or Bayesian; see text). A single number on top of the branch without an asterisk indicates that the support and topology are the same in both parsimony and Bayesian analyses. Finally, a single number below the branch without an asterisk indicates that the topology at that node is present in both analyses (parsimony and Bayesian) but the node is only supported in the Bayesian analysis (posterior probability shown). Clades A, B and C are labeled (see text).

as containing *Bejaria*, *Bryanthus* and *Ledothamnus* and map a single (homoplasious) synapomorphy for the tribe, that of separate petals. This character also occurs in other genera within the Ericaceae (i.e., *Elliottia, Ceratiola, Corema, Chimaphila, Orthilia* and *Pyrola*; Kron et al. 2002) some of which are represented as outgroups in this study.

Bejarieae is not monophyletic in any analysis in this study although the relationships outside of the terminal groups are poorly supported. Of the Bejarieae, only *Ledothamnus* and *Bryanthus* are strongly supported as closely related in both the parsimony and Bayesian results of the total evidence and chloroplast analyses (Figs. 1, 2, 5, 6). This clade has several potential morphological synapomorphies such as ericoid leaves, adaxial calyx stomata, a style articulated with the ovary and the lack of endothecium (Kron et al.

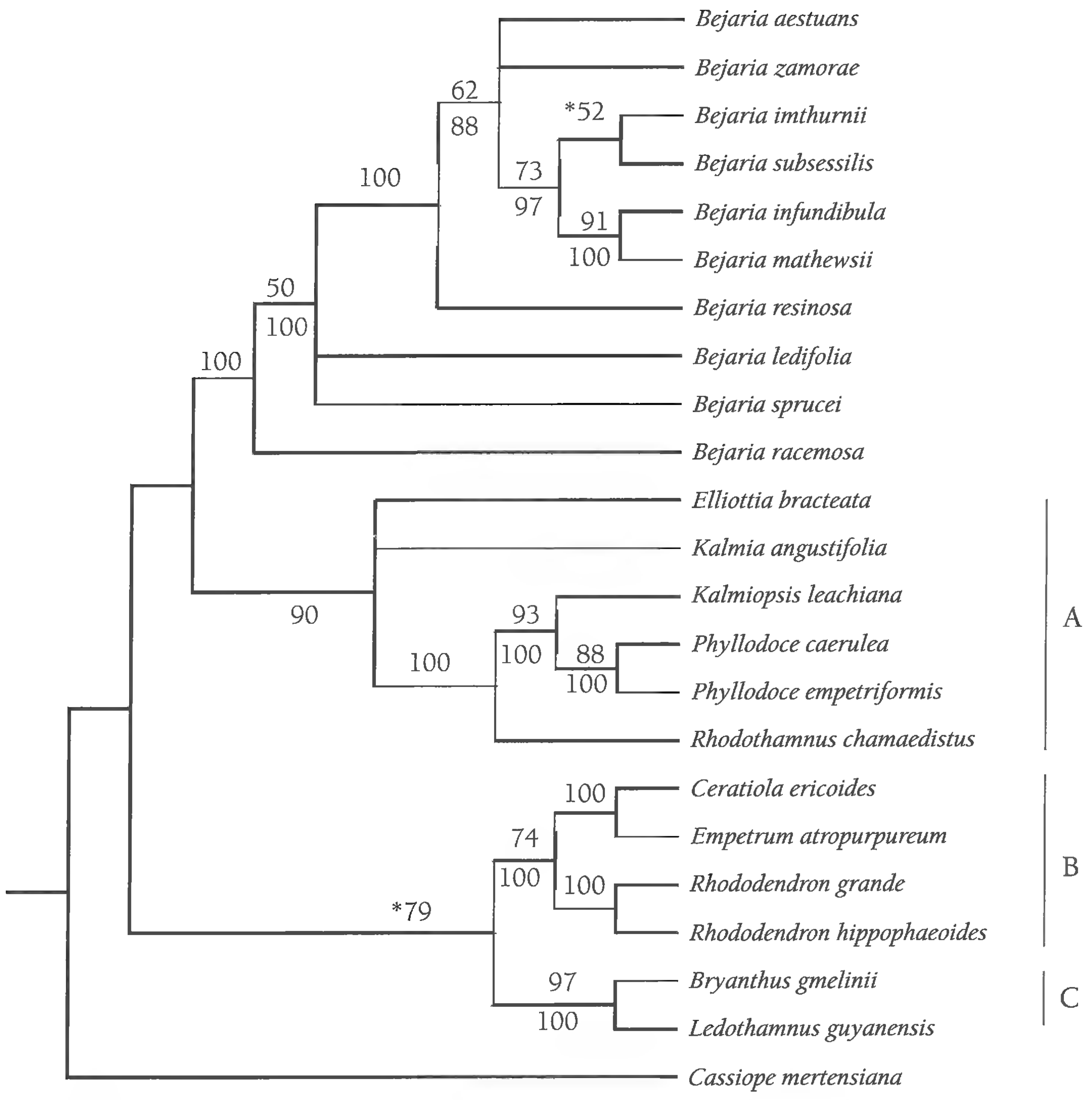
Bejaria aestuans
Bejaria zamorae
Bejaria imthurnii
Bejaria subsessilis
Bejaria infundibula
Bejaria mathewsii
Bejaria resinosa
Bejaria ledifolia
Bejaria sprucei
Bejaria racemosa
Elliottia bracteata
Kalmia angustifolia
Kalmiopsis leachiana
Phyllodoce caerulea
Phyllodoce empetriformis
Rhodothamnus chamaedistus
Ceratiola ericoides
Empetrum atropurpureum
Rhododendron grande
Rhododendron hippophaeoides
Bryanthus gmelinii
Ledothamnus guyanensis
Cassiope mertensiana
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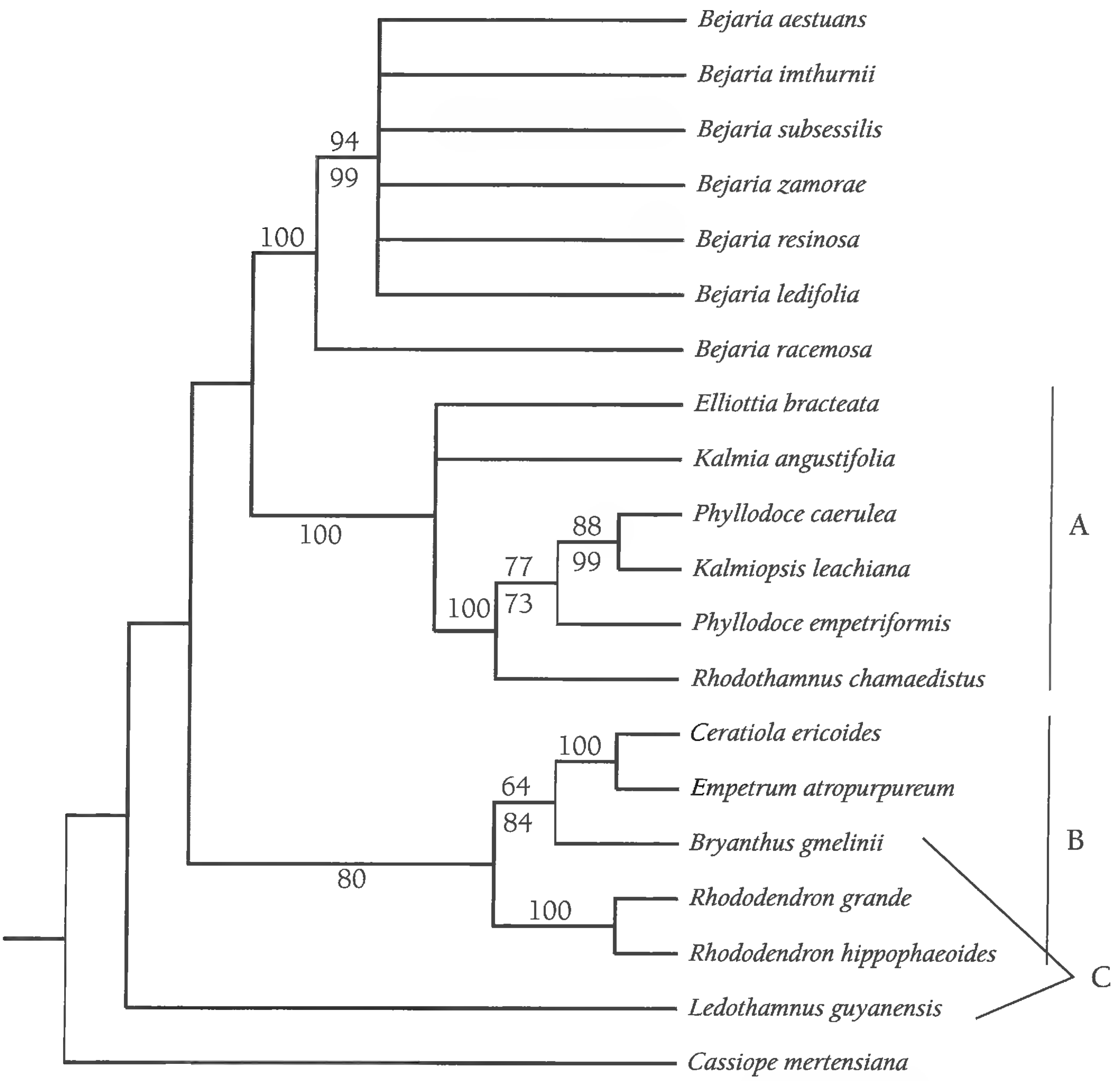
Fig. 2. Single consensus tree from a partitioned Bayesian analysis of the 5′*ndhF* and *matK* data sets. When two numbers on a branch are present, numbers above the branches represent bootstrap values greater than 50% and numbers below the branches indicate posterior probabilities. An asterisk next to a value indicates that the node is not present in the other analysis (parsimony or Bayesian; see text). A single number on top of the branch without an asterisk indicates that the support and topology are the same in both parsimony and Bayesian analyses. Finally, a single number below the branch without an asterisk indicates that the topology at that node is present in both analyses (parsimony and Bayesian) but the node is only supported in the Bayesian analysis (posterior probability shown). Clades A, B and C are labeled (see text).

2002). Parsimony and Bayesian analyses of *waxy* data do show *Ledothamnus* and *Bryanthus* in different positions within the trees (Figs. 3, 4), but these are not well supported either by bootstrap or posterior probability measures.

In his monograph of *Bejaria*, Clemants (1984) performed a morphological cladistic analysis of all 15 recognized species of *Bejaria* using 16 characters, eight of which were related to floral morphology. Variation within Rhododendroideae (Kron 1997) was so significant that its use as an outgroup required designating *B. racemosa* as a functional outgroup for characters 5–16 in the study (Clemants 1984). Only four characters did not vary in the subfamily outgroup (Rhododendroideae; Clemants 1984). The cladogram produced from


Bejaria aestuans
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Bejaria resinosa
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Empetrum atropurpureum
Bryanthus gmelinii
Rhododendron grande
Rhododendron hippophaeoides
Ledothamnus guyanensis
Cassiope mertensiana
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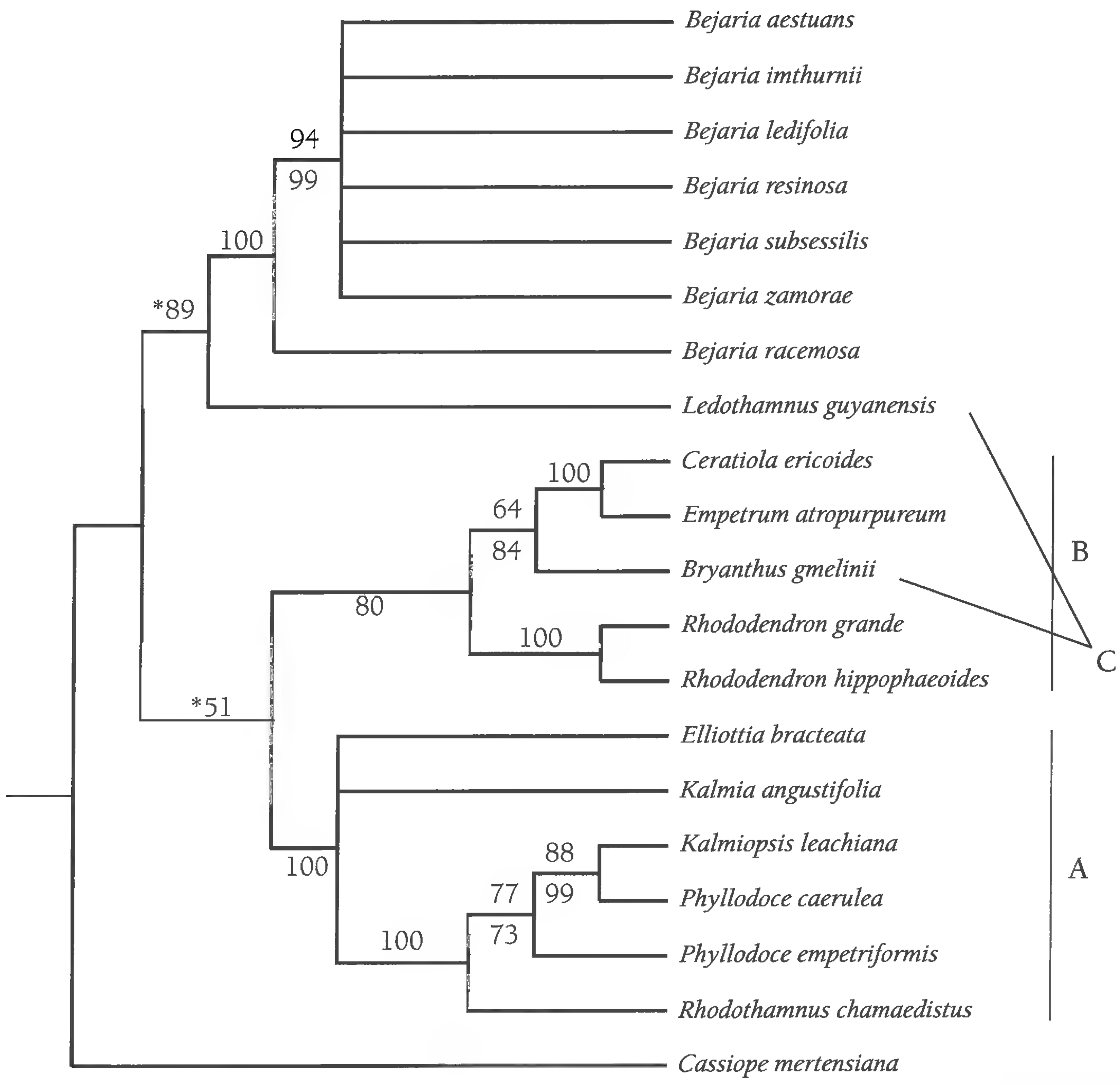
Fig. 3. Strict consensus of 1369 most parsimonious trees (L = 193, CI = 0.74, RI = 0.85) obtained in the analysis of the *waxy* data. *Bejaria infundibula, B. mathewsii* and *B. sprucei* were excluded from this analysis due to large amounts of missing data in the *waxy* gene. When two numbers on a branch are present, numbers above the branches represent bootstrap values greater than 50% and numbers below the branches indicate posterior probabilities. A single number on top of the branch without an asterisk indicates that the support and topology are the same in both parsimony and Bayesian analyses. Finally, a single number below the branch without an asterisk indicates that the topology at that node is present in both analyses (parsimony and Bayesian) but the node is only supported in the Bayesian analysis (posterior probability shown). Clades A, B and C are labeled (see text).

the four characters placed *B. racemosa* as sister to all other *Bejaria* species (Clemants 1984). In the cladogram based on these four characters, a mucilaginous epidermis was a synapomorphy for all species in Central, South America and Cuba (Clemants 1984). *Bejaria racemosa* had the autapomorphy of stomata on both leaf surfaces (Clemants 1984). Flower shape was divided into three states: tube-shaped, cup-shaped and funnel-shaped (Clemants 1984). *Bejaria infundibula* alone possessed a funnel-shaped corolla, *B. nana* and *B. tachirensis* possessed cup-shaped corollas and the presence of tube-shaped corollas was a synapomorphy for the clade containing *B. ledifolia, B. mathewsii, B. resinosa, B. sprucei,* and *B. zamorae* (Clemants 1984). *Bejaria racemosa* and *B. nana* share the presence of an apical bracteole (compared to basal or medial) but this character has possibly evolved twice within *Bejaria* (Clemants 1984). The analyses in the present study represent a much smaller sample of *Bejaria* than Clemants (1984) due to problems with DNA extractions and PCR amplifica-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Ceratiola ericoides
Empetrum atropurpureum
Bryanthus gmelinii
Rhododendron grande
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Fig. 4. Single consensus tree from a Bayesian analysis of the *waxy* data set. *Bejaria infundibula*, *B. mathewsii* and *B. sprucei* were excluded from this analysis due to large amounts of missing data in the *waxy* gene. When two numbers on a branch are present, numbers above the branches represent bootstrap values greater than 50% and numbers below the branches indicate posterior probabilities. An asterisk next to a value indicates that the node is not present in the other analysis (parsimony or Bayesian; see text). A single number on top of the branch without an asterisk indicates that the support and topology are the same in both parsimony and Bayesian analyses. Finally, a single number below the branch without an asterisk indicates that the topology at that node is present in both analyses (parsimony and Bayesian) but the node is only supported in the Bayesian analysis (posterior probability shown). Clades A, B and C are labeled (see text).

tion of old material as well as obtaining rare taxa. However our outgroup taxa include many members of previously circumscribed Rhodendroideae (with the exception of Empetreae) so our results are useful when compared to those of Clemants' (1984).

The revision of *Bejaria* by Clemants (1995) differed from previous revisions of the genus due to its focus on corolla shape as a delimiting character for species recognition. However, the total evidence analyses in this study (Figs. 5, 6) indicate that a tubular corolla such as that found in *B. ledifolia*, *B. resinosa*, and *B. zamorae* has likely evolved as least twice within *Bejaria*. The placement of clades with taxa that possess bell-shaped or spreading corollas (*B. aestuans*, *B. imthurnii*, and *B. subsessilis*) intercalated within clades that represent

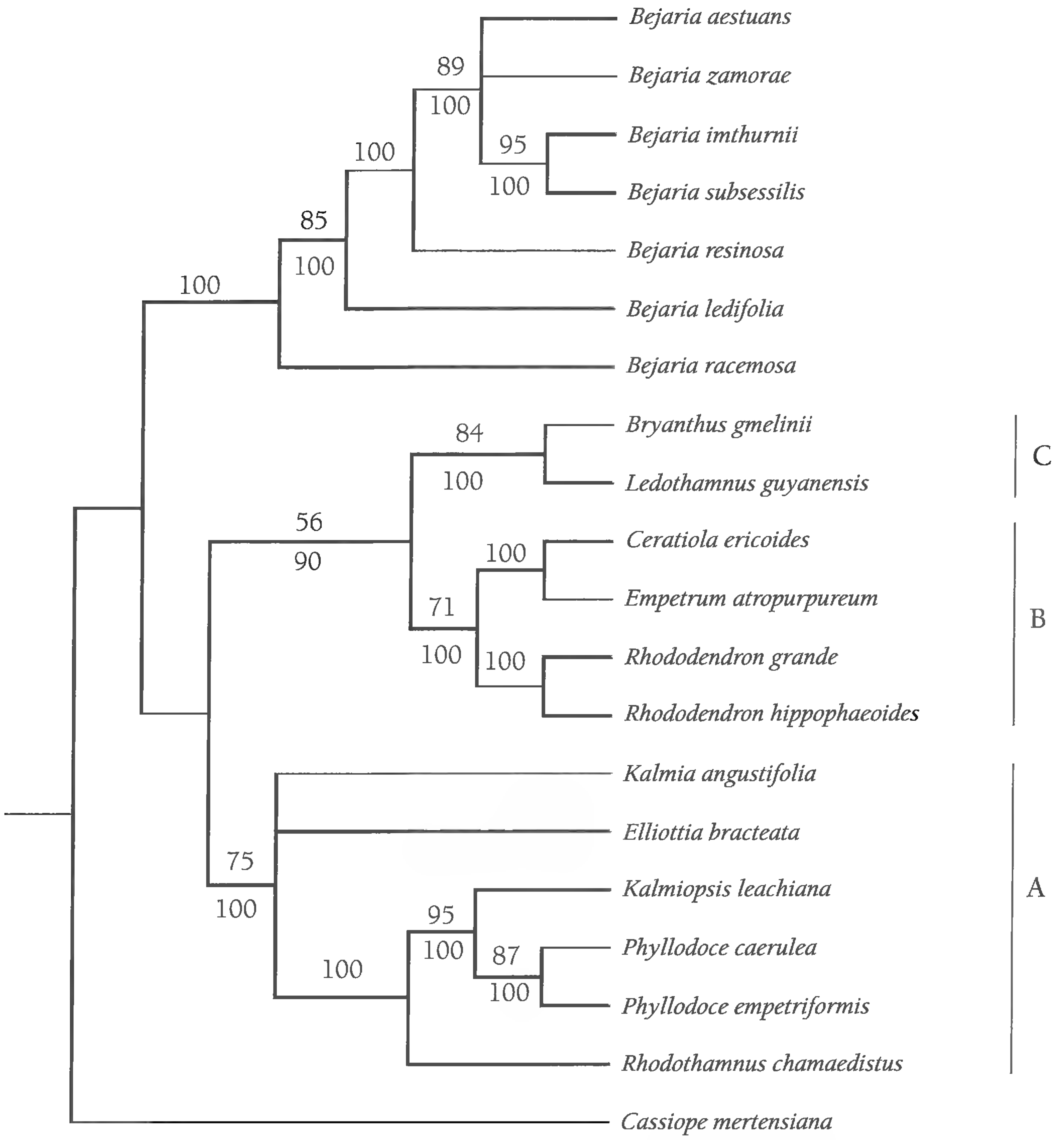
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Fig. 5. Strict consensus of 6 most parsimonious trees (L = 1142, CI = 0.62, RI = 0.73) obtained in the analysis of the *ndhF* 5', *matK* and *waxy* data combined. *Bejaria infundibula*, *B. mathewsii* and *B. sprucei* were excluded from this analysis due to large amounts of missing data in the *waxy* gene. When two numbers on a branch are present, numbers above the branches represent bootstrap values greater than 50% and numbers below the branches indicate posterior probabilities. A single number on top of the branch without an asterisk indicates that the support and topology are the same in both parsimony and Bayesian analyses. Finally, a single number below the branch without an asterisk indicates that the topology at that node is present in both analyses (parsimony and Bayesian) but the node is only supported in the Bayesian analysis (posterior probability shown). Clades A, B and C are labeled (see text).

taxa with tubular corollas indicates that corolla shape designations may not be phylogenetically informative within the genus.

Phylogenetic relationships among the species of *Bejaria* sampled in this study are identical in both the Bayesian and parsimony total data analyses and are well supported. In our analyses a novel, strongly supported relationship between *B. imthurnii* and *B. subsessilis* was found (Figs. 5, 6), although Clemants' (1984) study does not support this relationship. Instead, his results indicate that *B. subsessilis* is sister to *B. cubensis*

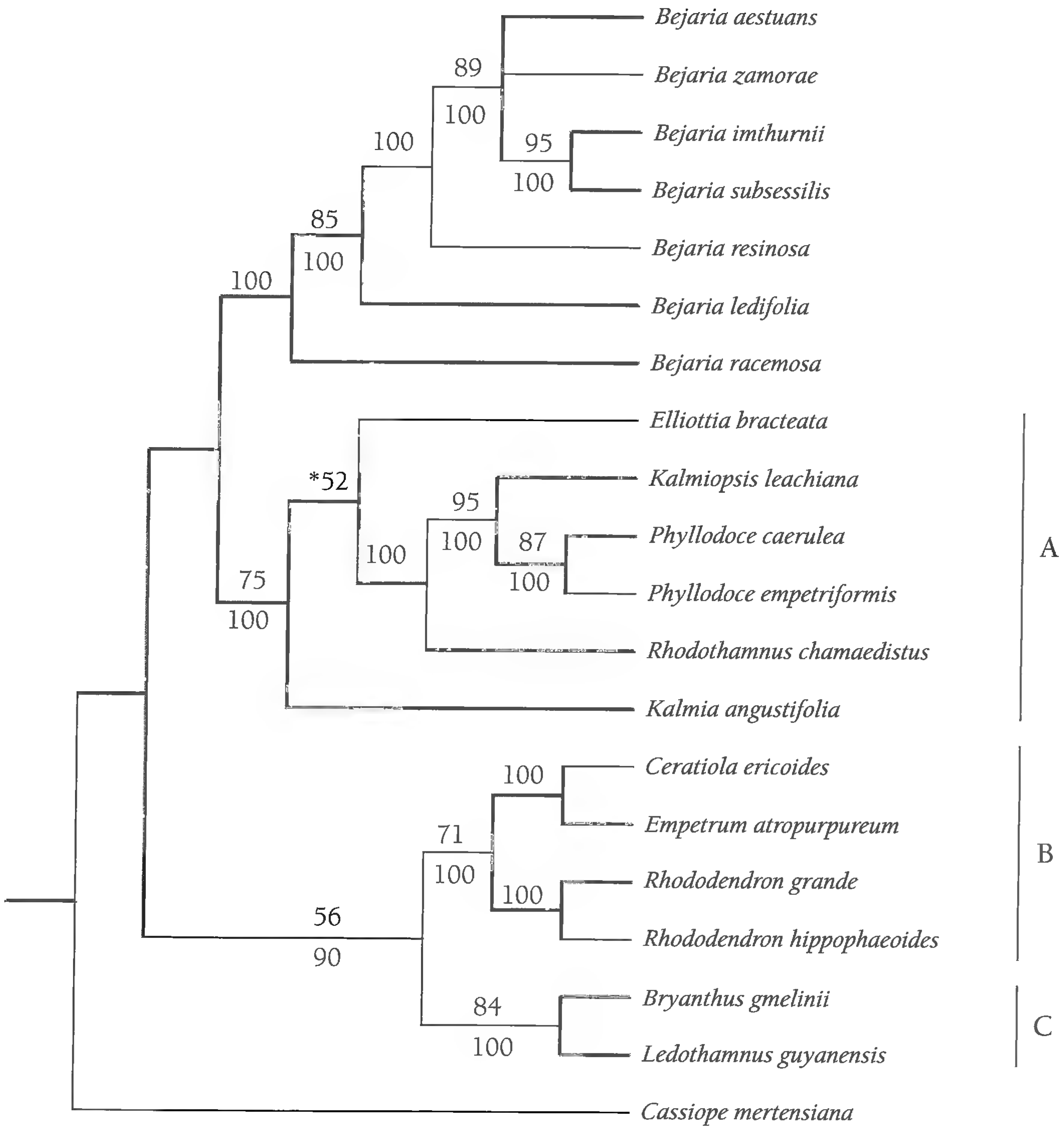
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Fig. 6. Single consensus tree from a partitioned Bayesian analysis of the *ndhF 5', matK* and *waxy* data sets. *Bejaria infundibula, B. mathewsii* and *B. sprucei* were excluded from this analysis due to large amounts of missing data in the *waxy* gene. When two numbers on a branch are present, numbers above the branches represent bootstrap values greater than 50% and numbers below the branches indicate posterior probabilities. An asterisk next to a value indicates that the node is not present in the other analysis (parsimony or Bayesian; see text). A single number on top of the branch without an asterisk indicates that the support and topology are the same in both parsimony and Bayesian analyses. Finally, a single number below the branch without an asterisk indicates that the topology at that node is present in both analyses (parsimony and Bayesian) but the node is only supported in the Bayesian analysis (posterior probability shown). Clades A, B and C are labeled (see text).

due to the shared presence of a long floral bract (data not shown). *Bejaria imthurnii* and *B. subsessilis* do not share geographic ranges: *B. imthurnii* is endemic to the summits of Cerro Roraima and Cerro Kukenán on the border of Venezuela, Brazil and Guyana while *B. subsessilis* is endemic to Loja, Ecuador (Clemants 1995). *Bejaria imthurnii* shares some diagnostic morphological characters with *B. steyermarkii* and *B. neblinensis* (Clemants 1995). The three taxa share small, short-petioled leaves and campanulate corollas (Clemants 1995). Clemants (1995) noted that *B. subsessilis* possessed some characters that were intermediate between

B. aestuans and *B. resinosa* (e.g., rachis similar to *B. aestuans*, subsessile leaves with obtuse leaf bases like *B. resinosa*) suggesting that *B. subsessilis* possibly arose as a hybrid between *B. aestuans* and *B. resinosa*. In addition, some populations of *B. subsessilis* have distorted tubular corollas and two of the four pollen grains in the tetrads are aborted (Clemants 1995).

The relationships of *Bejaria aestuans* and *B. zamorae* to the *B. imthurnii* + *B. subsessilis* clade (89% bt, 100% $_{P}$P respectively; Figs. 5, 6) are not resolved. While these species share several morphological traits, whether or not they indicate relationship remains to be tested. *Bejaria aestuans* is the most geographically widespread and morphologically variable species in the genus: it is found from Mexico to Bolivia (Clemants 1995). *Bejaria zamorae*, conversely, is endemic to the Rio Zamora valley in Ecuador (Clemants 1995). *Bejaria zamorae* shares several taxonomically diagnostic characters with both *B. aestuans* and *B. sprucei* (not sampled in the total data analyses; Clemants 1995). *Bejaria zamorae* has distinct thin and long pedicels and a strongly tubular corolla like *B. sprucei*. However, *B. zamorae* also exhibits slightly exserted stamens and a 7-merous corolla similar to *B. aestuans* (Clemants 1995). *Bejaria sprucei* exhibits a disjunct geographic distribution both north and south of the Ecuadorian volcanic region: one region includes the Guyana Highlands area and the mountains near Táchira and Anzoátegui, Venezuela and the other geographic region for the species is in northeastern Peru near San Martín (Clemants 1995).

Bejaria resinosa is sister to the clade containing *B. aestuans, B. zamorae, B. imthurnii* and *B. subsessilis* (Figs. 5, 6). *Bejaria resinosa* shares tubular flowers and long calyx lobes with *B. ledifolia* and *B. mathewsii* (not sampled in total evidence analyses) and these are considered indicators of relationship by Clemants (1995). In general, our results agree that *B. ledifolia* and *B. resinosa* are generally related (Figs. 5, 6) but they are not placed as sister in our analyses, indicating that such characters as obtuse to truncate leaf bases, short petioles, and long calyx lobes may not be phylogenetically informative.

This study indicates that additional approaches to resolve these closely related species are desired. A more complete sampling of the species within the genus, especially the rare and endemic taxa is important. Additional morphological cladistic work that builds on Clemants' (1984, 1995) studies are likely to improve our understanding of relationships within the genus and hyper-variable chloroplast or nuclear markers may be able to differentiate among these taxa more clearly. Population-level studies of widespread taxa such as *B. aestuans* and *B. mathewsii* which include samples from the geographic and morphological extremes of each species could clarify the potentially complicated relationships within this genus.

ACKNOWLEDGMENTS

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BOOK REVIEW

Sean Carrington. 2007. **Wild Plants of Barbados.** (ISBN-10: 1405094079, ISBN-13: 978-1405094078, pbk.). MacMillan Caribbean Publishers, Between Towns Road, Oxford, OX4 3PP, United Kingdom. (**Orders:** www.macmillan-caribbean.com, caribben@macmillan.com, +44 (0)1865-405843 fax). $10.69, 248 pp., color photographs, 8 1/4" × 5 1/2".

This fully revised and updated edition now includes several plant species previously unrecorded for Barbados. This book aims to enable the reader to identify the flowering plants found in the wild in Barbados, plants many people would regard as just bush. 535 plant entries are included, over half with color photographs and clear, precise, and easy-to-follow descriptions for accurate identification. Plants are grouped by Family, identified with the current scientific name and the local common name. Details are provided about the plant's general distribution, its habitat in Barbados, and information relating to its uses.

Botanical terms are explained and illustrated with labeled line drawings and a glossary, both of which are useful for the beginner. A quick and easy method is described for use in the field to help identify the plants. The introduction explains the basics of plant classification and surveys the vegetation types that constitute the plant communities of Barbados. A three-page bibliography, index, and varied appendix are included among the end material.

The first edition published in 1993 had 128 pages detailing 520 plants. A page count comparison is deceptive as the second edition covers only 15 more plants and is a smaller book. The layout is superior as the photographs accompany the plant description, while in the first edition the photographs were in a separate section. This makes the current edition much easier to use.

Highly recommended for public libraries with an interest in the flora of the Caribbean and college and universities with an active botany or plant biology program. Interested individuals will also benefit from this book.

Author Sean Carrington is Professor of Plant Biology at the University of the West Indies, Barbados, carrying out research on the biochemistry of fruit ripening as well as on aspects of Caribbean flora. He is the author of *Wild Plants of the Eastern Caribbean* and lead author of *A-Z of Barbados Heritage.—Gary L. Jennings, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

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UNDERSTANDING *OLIGACTIS* (ASTERACEAE: LIABEAE): THE TRUE IDENTITY OF *O. SESSILIFLORA* AND *O. VOLUBILIS*

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ABSTRACT

The neotropical genus *Oligactis* contains 13 species grouped in two subgenera: *Andromachiopsis* and *Oligactis*. Subgenus *Oligactis* has four species that occur mainly in Colombia and one of them reaches Central America and Venezuela. New synonyms *Oligactis garcia-barrigae* and *O. valeri* are proposed under the species *O. volubilis* and *O. sessiliflora*, respectively. The synonyms *Liabum meridense, O. biattenuata*, and *O. boyacensis* are tranferred from *O. volubilis* to *O. sessiliflora*. *O. volubilis* is illustrated for the first time. In addition, a key to the species of the subgenus *Oligactis* is provided.

Key Words: Asteraceae, Colombia, Compositae, Liabeae, *Oligactis sessiliflora, O. volubilis*

RESUMEN

El género neotropical *Oligactis* contiene 13 especies agrupadas en dos subgéneros: *Andromachiopsis* y *Oligactis*. El subgénero *Oligactis* incluye cuatro species distribuidas principalmente en Colombia, de las cuales una alcanza América Central y Venezuela. Se proponen a *Oligactis garcia-barrigae* y *O. valeri* como sinónimos de las especies *O. volubilis* y *O. sessiliflora*, respectivamente. Se trafieren los sinónimos *Liabum meridense, O. biattenuata* y *O. boyacensis* de *O. volubilis* a *O. sessiliflora*. Se ilustra a *O. volubilis* por primera vez. Además, se provee una clave para reconocer a las especies del subgénero *Oligactis*.

Palabras Clave: Asteraceae, Colombia, Compositae, Liabeae, *Oligactis sessiliflora, O. volubilis*

Oligactis (Kunth) Cass. contains 13 species confined to cloud forests from western Venezuela to northern Peru and one species only that reaches forests of Panama and Costa Rica (Dillon & Sagástegui Alba 1994; Funk et al. 1996). *Oligactis* is distinct among Liabean genera by its scandent or climbing habit, pinnatinerved leaves, capitula grouped in axillary or terminal capitulescences, and glandular cypselae. A modern view of *Oligactis* was provided by Robinson (1983) who illustrated the first evolutionary tree for Liabeae. Phylogenetic analyses based on morphological characters suggested that *Oligactis* is closely related to *Liabum* Adans. (Bremer 1994; Funk et al. 1996; Gutiérrez 2004). On the other hand, in a preliminary phylogenetic study conducted using sequences of the internal transcribed spacer (ITS) 1 and 2 and the 5.8S gene, *Oligactis* was sister to and closely related to the natural group formed by *Dillandia* Funk & H. Rob. and *Liabum* (Gutiérrez et al. 2007).

Originally, *Oligactis* was described by Kunth (1818) as a section of genus *Andromachia* Humb. & Bonpl. (currently a synonym of *Liabum*) with three species: *Andromachia nubigena* Kunth, *A. sessiliflora* Kunth, and *A. volubilis* Kunth. Years later, Bentham (1873) included the species of *Oligactis* in *Liabum* s.l. section *Oligactis*. During a hundred years, this general point of view of *Liabum* was followed by different authors (i.e. Hoffmann 1897; Blake 1927) with only Rydberg (1927) and Cabrera (1954) recognizing separate genera with the general characters of *Liabum*.

In 1964, Aristeguieta recorded six species of *Liabum* s.l. from Venezuela, among them *L. sessiliflorum* (Kunth) Less. and *L. volubile* (Kunth) Less. However, some features indicated by Aristeguieta in *L. volubile* did not fit with its original description. Subsequent check-lists followed Aristeguieta (Badillo 1996; Badillo 2001).

In 1974 Robinson and Brettell resurrected *Oligactis* and created two subgenera: *Andromachiopsis* and *Oligactis*. Also, they transferred several species originally described under the broad concept of *Liabum* to

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J. Bot. Res. Inst. Texas 2(2): 1207 – 1213. 2008

Oligactis, most of them to subgenus *Andromachiopsis*. According to those authors, subgenus *Oligactis* included eight species: the three species described by Kunth (1818) under *Andromachia* section *Oligactis*, plus *O. biattenuata* (Rusby) H. Rob. & Brettell, *O. boyacensis* (Cuatrec.) H. Rob. & Brettell, *O. latifolia* (Hieron.) H. Rob. & Brettell, *O. mikanioides* (S.F. Blake) H. Rob. & Brettell, and *O. valeri* (Standl.) H. Rob. & Brettell. Then, Robinson (1983) recognised six species under subgenus *Oligactis* since he excluded *O. nubigena* (Kunth) Cass., noticed *O. biattenuata* and *O. boyacensis* as synonyms, and cited the last species described *O. garcia-barrigae* H. Rob. (Robinson 1980). He hypothesized this subgenus included the most specialized element of the genus *Oligactis* due to its axillary or terminal capitulescence, six to 10 florets per capitulum, and papillose anther apical appendages.

In spite of floristic treatments and check-lists from Costa Rica (Standley 1938), Ecuador (Robinson 1978; Robinson 1999), Peru (Dillon & Hensold 1993), and Venezuela (Aristeguieta 1964; Badillo 2001), a revision of *Oligactis* has not been made. While performing a revision of the genus *Liabum* (Gutiérrez 2004), species belonging to *Oligactis* subgenus *Oligactis* have been studied. The object of this work is to determinate the real taxonomic identity and synonyms of *O. sessiliflora* (Kunth) DC. and *O. volubilis* (Kunth) Cass.

MATERIALS AND METHODS

The morphological and taxonomic studies were based on specimens, photos and/or digital images kept at GH, K, LP, NY, P, SI, MO, US, and VEN. The data derived from the specimens were supplemented by information from the literature. For microscopic examination, vegetative and reproductive parts were rehydrated, treated with a clearing process, stained with 2% safranin, and mounted on microscope slides. Drawings were made using an Olympus CH2 microscope with camera-lucida.

RESULTS AND DISCUSSION

The status of Oligactis volubilis

In the protologue, Kunth (1818) distinguished of *Andromachia volubilis* (currently *O. volubilis*) by its scandent habit, lanceolate-linear leaves, and pedunculate capitula in terminal panicles with approximately six florets per capitulum, and *A. sessiliflora* (currently *O. sessiliflora*) by its shrubby habit, oblong leaves (and ovate, according to the original illustration), axillary and terminal panicles, and sessile and densely grouped capitula with approximately eight florets per capitulum. In spite of several traits in common, both species can be easily distinguished (Table 1).

Aristeguieta (1964) under the broad concept of *Liabum* first treated *Liabum meridense* Badillo as a synonym of *L. volubile* based on the specimens *Gehriger 427* (type of *L. meridense*) and *Badillo 613*. In his description, he characterized *L. volubile* by its lanceolate leaves (2–4 cm wide), pedunculate capitula, and 10–15 florets per capitulum. However, all the specimens studied by Aristeguieta seem to belong to *O. sessiliflora* because none of the specimens analysed had narrowly elliptical or linear leaves, the most conspicuous trait of *O. volubilis*. On the other hand, he characterized *L. sessiliflorum* by its elliptical to lanceolate leaves (2.5–6 cm wide), sessile to slightly pedunculate capitula, and approximately 10 florets per capitulum. According to this author both *O. volubilis* and *O. sessiliflora* would share almost the same lamina width and amount of florets per capitulum.

In 1980, Robinson described *O. garcia-barrigae* which was distinguished from *O. volubilis* (and *O. sessiliflora*) by its narrow leaves, often closely spaced or clustered on lateral branches, and six florets per capitulum (three ray and three disc florets). However, my analysis revealed that the type specimens of *O. garcia-barrigae* are strikingly similar to the type of *Oligactis volubilis* (Fig. 1). The specimens of both taxa share the following combination of characters: narrowly elliptical or lineal leaves, densely grouped capitula in axillary panicles, and approximately six florets per capitulum (commonly three ray and three disc florets). Thus, *O. garcia-barrigae* is proposed as a synonym of *O. volubilis*.

On the other hand, Robinson (1983) included the Colombian species *Oligactis biattenuata* and *O. boyacensis* described by Rusby and Cuatrecasas respectively, under *O. volubilis* and maintained the concept

Table 1. Characters in *Oligactis sessiliflora* and *O. volubilis*.

Character	***O. sessiliflora*** **(Kunth) DC.**	***O. volubilis*** **(Kunth) Cass.**
Leaf arrangement	Decussate, not grouped on nodes	Decussate, densely grouped on nodes
Lamina shape	Elliptical or ovate, sometimes narrowly	Narrowly elliptical or linear
Lamina width	2 cm to 6 cm	0.1 cm to 0.5 cm
Lamina margin	Subentire or serrulate	Entire
Leaf margin intrasection	Planate	Revolute
Capitulescence	Axillary and terminal paniculiform or glomerate racemiform cymes	Axillary and terminal paniculiform cymes
Involucre	Sessile or slightly pedunculate	Slightly pedunculate
Ray florets	3 to 6	3
Disc florets	7 to 9	3

of Aristeguieta regarding *Liabum meridense* as synonym of the last species (*O. volubilis*). However, both Colombian's species (*O. biattenuata* and *O. boyacensis*) and *L. meridense* fit strickly with *O. sessiliflora* specially regarding leaf shape, quantity of florets per capitulum, and ratio between ray and disc florets. Therefore, the illustration of *O. volubilis* (Robinson 1983) actually represents *O. sessiliflora*. According to the findings above described, *L. meridense, O. biattenuata*, and *O. boyacensis* are excluded from *O. volubilis*.

Oligactis volubilis (Kunth) Cass., in F. Cuvier, Dict. sci. nat., ed. 2, 36:17. 1825. (**Fig. 2**). *Andromachia volubilis* Kunth, in Humboldt, Bonpland & Kunth, Nov. gen. sp., ed. Folio, 4:80. 1818. Type: Probably COLOMBIA. Department and locality uncertain: crescit in monte Antisana Quitensium?, *Humboldt & Bonpland s.n.* (holotype: P [digital image LP!]) (see discussion below). *Diplostephium volubile* (Kunth) Spreng., Syst. veg. 3:543. 1826. *Liabum volubile* (Kunth) Less., Linnaea 6:704. 1831.

Oligactis garcia-barrigae H. Rob., Phytologia 46:100. 1980. Syn. nov. Type: COLOMBIA. Cundinamarca-Meta: Cordillera Oriental, vertiente occidental, Fómeque, camino al Lago de Chingaza y cordillera de Cerro Verde, 1900–3200 m, 26–28 Dec 1962, *García-Barriga 17689* (holotype: COL; isotypes GH!, US [digital image LP!]).

The Antisana (currently Antizana) mountain (Ecuador) was cited by Kunth (1818) with doubt as the original locality of *Andromachia volubilis*. In addition, the holotype kept at P does not have any data of the locality and there are no additional type materials of this species. Robinson (1999) understood the locality cited by Kunth was a mistake and excluded *Oligactis volubilis* from Ecuador. Thus, Colombia is probably the country where the type was collected by Humboldt and Bonpland, since the specimens assigned to *O. volubilis* from Costa Rica (Standley 1938), Panama (Robinson 1999) and Venezuela (Aristeguieta 1966), actually belong to *O. sessiliflora*. On the other hand, the synonym *O. garcia-barrigae* proposed in this work was collected in central Colombia and its types currently represent the unique materials of *O. volubilis* with reliable data of collection area.

The status of *Oligactis sessiliflora*

The analysis revealed that the type specimens of *Liabum meridense*, *Oligactis biatenuatta*, *O. boyacensis* (excluded in this work from *O. volubilis*), and *O. valeri* match *Oligactis sessiliflora*. The specimens of those taxa share the following combination of characters: elliptical, ovate or sometimes narrowly ovate leaves, densely grouped capitula in axillary and terminal panicles or glomerate racimous cymes, sessile or slightly pedunculate capitula, and eight to 15 florets per capitulum. Thus, *L. meridense*, *O. biatenuatta*, *O. boyacensis*, and *O. valeri* are proposed as synonyms of *O. sessiliflora*.

Oligactis sessiliflora (Kunth) DC., Prodr. 5:96. 1836. *Andromachia sessiliflora* Kunth, in Humboldt, Bonpland & Kunth, Nov. gen. sp., ed. Folio, 4:80. 1818. Type: Probably COLOMBIA. Department and locality uncertain: crescit in Regno Peruviano? *Humboldt & Bonpland s.n.* (holotype: P [photos LP!, SI!]; isotype: B [photo FM 18129, SI!], probably destroyed). *Oligactis apodocephala* Cass., in F. Cuvier, Dict. sci. nat., ed. 2, 36:17. 1825. *Diplostephium sessiliflorum* (Kunth) Spreng., Syst. veg. 3:543. 1826. *Liabum sessiliflorum* (Kunth) Less., Linnaea 6:703. 1831. *Oligactis sessiliflora* (Kunth) H. Rob. & Brettell, Phytologia 28:58. 1974.

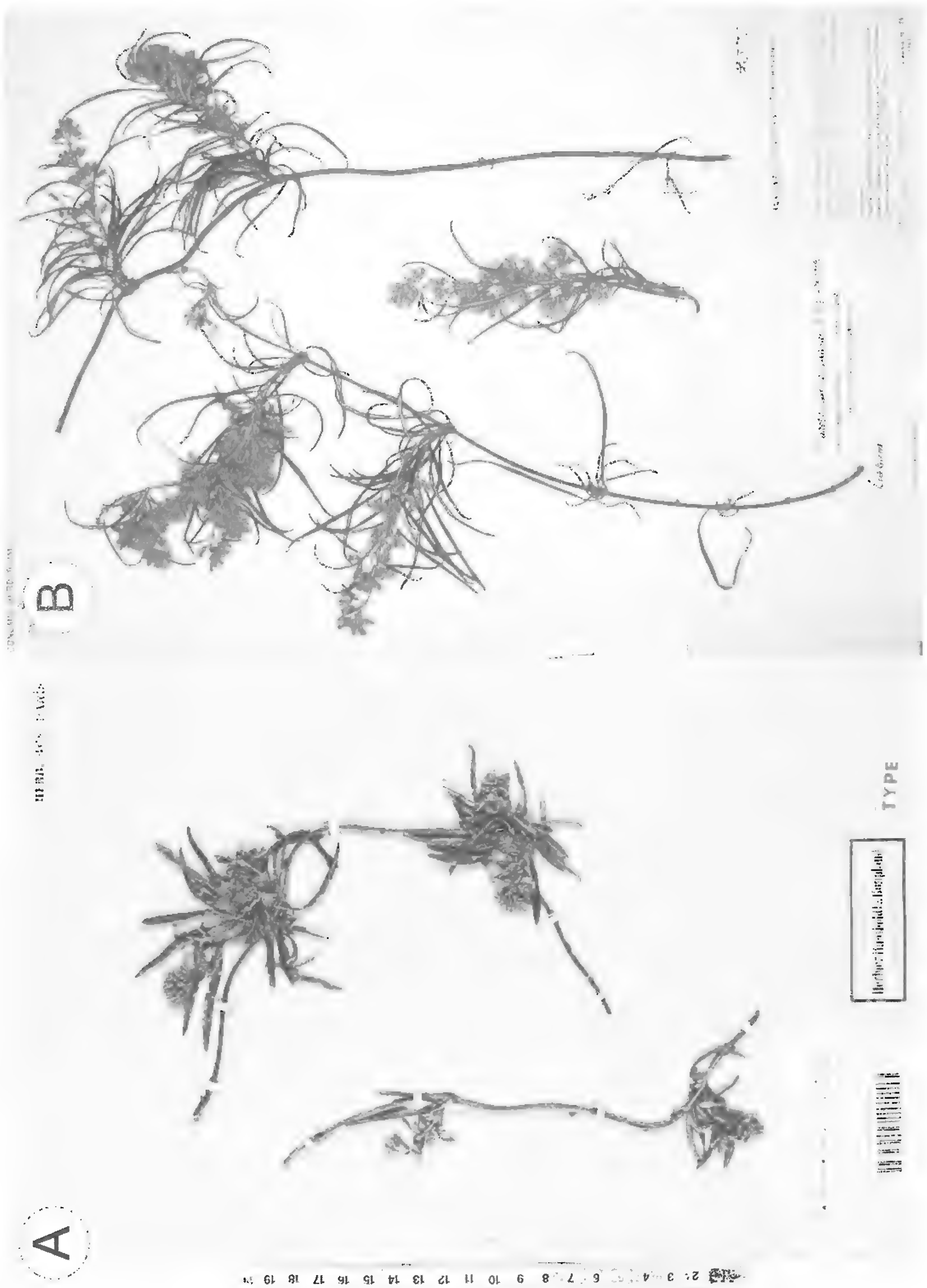

Fig. 1. A. *Andromachia volubilis* (holotype, P). **B.** *Oligactis garcia-barrigae* (isotype, GH).

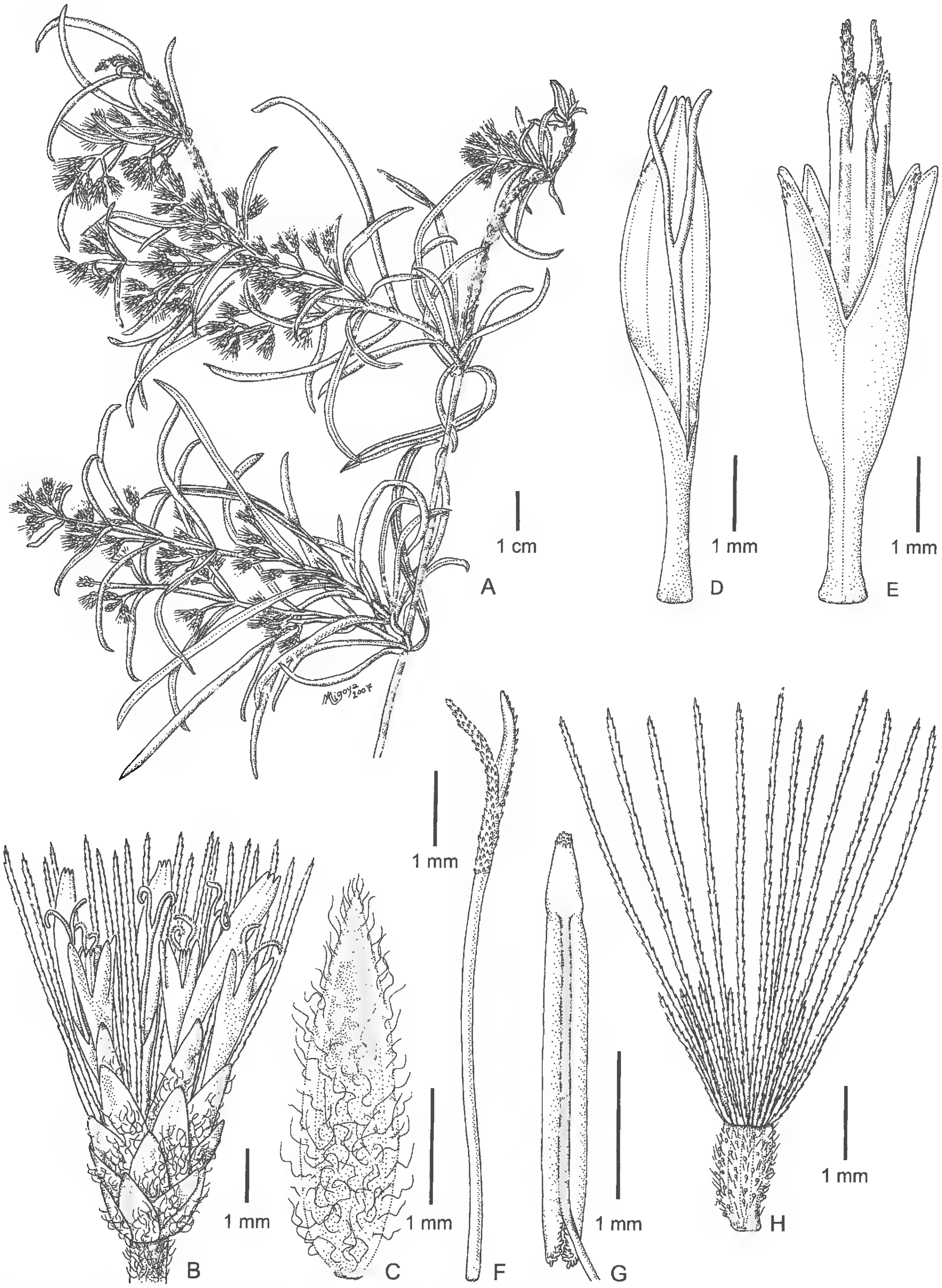
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Fig. 2. *Oligactis volubilis*. **A.** Habit. **B.** Capitulum. **C.** Involucral bract. **D.** Ray floret. **E.** Disc floret. **F.** Style of disc floret. **G.** Anther. **H.** Cypsela and pappus (*García-Barriga 17689*, GH).

Liabum tovarense V.M. Badillo, Bol. Soc. Venez. Ci. Nat. 10:314. 1946. Type: VENEZUELA. Aragua: Colonia Tovar, 1800–2000 m, Dec 1942, *Allart 370* (holotype: VEN [digital image LP!]; isotype: US [digital image LP!]).

Liabum biattenuatum Rusby, Descr. S. Amer. pl.:159. 1920. Syn. nov. Type: COLOMBIA. Magdalena: Santa Marta, Sierra del Líbano, 5500 ft, 19 Jan 1898/1899, *Smith 2013* (holotype: NY [digital image LP!]; isotypes: K, MO, P [photos LP!, SI!], S, US [digital image LP!]). *Oligactis biattenuata* (Rusby) H. Rob. & Brettell, Phytologia 28:57 1974.

Liabum boyacense Cuatrec., Revista Acad. Colomb. Ci. Exact. 6:61. 1944. Syn. nov. Type: COLOMBIA. Boyacá: Cordillera Oriental, entre Moniquirá y Arcabuco, 2150 m, 25 Feb 1940, *Pérez Arbeláez & Cuatrecasas 8164* (holotype: COL; isotypes NY [digital image LP!]), US [digital image LP!]). *Oligactis boyacensis* (Cuatrec.) H. Rob. & Brettell, Phytologia 28:57. 1974.

Liabum meridense V.M. Badillo, Bol. Soc. Venez. Ci.. Nat. 10:314. 1946. Syn. nov. Type: VENEZUELA. Mérida: Tabay, selva de la Isla y El Rincón, 2500–2700 m, 8 Sep 1930, *Gehriger 427* (holotype: VEN [digital image LP!]; isotype US [digital image LP!]).

Liabum valeri Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 18:1490. 1938. Syn. nov. Type: COSTA RICA. San José: Near Finca La Cima, above Los Lotes, N of Copey, 2100–2400 m, 21/22 Dec 1925, *Standley 42555* (holotype: F; isotype: US [digital image LP!]). *Oligactis valeri* (Standl.) H. Rob. & Brettell, Phytologia 28:58. 1974.

Iconography.—Kunth 1818, tab. 338; Robinson 1983: 40, fig. 9 (sub nom. *Oligactis volubilis*).

Candolle (1836) recognized under *Andromachia* the three species of Kunth´s section *Oligactis*. In the synonymic list he assigned the combination *Oligactis sessiliflora* to Cassini. However, Cassini never made this combination because he created the superfluous name *O. apodocephala* (Cassini 1825). Recently, Robinson and Brettell (1974) made the combination *Oligactis sessiliflora*. Nevertheless, according to The International Code of Botanical Nomenclature (ICBN), Art. 33.1, 2, and 4, the valid combination was made by Candolle.

The current four species of *Oligactis* subgenus *Oligactis* can be distinguished as follows:

1. Leaf lamina linear to narrowly elliptical, margins entire; capitulum usually 6-flowered __________ **O. volubilis**
1. Leaf lamina elliptical to ovate, margins subentire or serrulate; capitulum of (8–)10–15 florets.
    2. Leaf adaxial surface hirsute __________ **O. latifolia**
    2. Leaf adaxial surface glabrous.
        3. Sessile or subsessile capitula densely grouped in panicles or glomerate racemes __________ **O. sessiliflora**
        3. Pedunculate capitula laxly grouped in panicles __________ **O. mikanioides**

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BOOK REVIEW

JEFFREY GREENE (AUTHOR), WITH MARGARET BAMBERGER (ILLUSTRATOR). 2007. **Water from Stone: the Story of Selah, Barmberger Ranch Preserve.** (ISBN 10: 1585445932, ISBN 13: 978-1585445936, hbk.). Texas A&M University Press, Lewis Street, 4354 Texas A&M University, College Station, Texas 77843-4354, U.S.A. (**Orders:** www.tamu.edu/upress, 800-826-8911). $24.95, 232 pp., illustrations, 6" × 9".

Growing up in rural Ohio during the Great Depression and World War II, Bamberger learned at an early age to shun waste, grow food productively, and admire the Amish for living in harmony with the land. His mother taught him to love the natural world and gave him a book that would set the course for his life: *Pleasant Valley*, by Louis Bromfield, a visionary American advocate for land restoration. Inspired by his new role model, Bamberger would say, "If I ever make money, I want to do what Bromfield did."

Author Jeffrey Greene provides a portrait of J. David Bamberger's unlikely transformation from first, a vacuum cleaner salesman, then to co-founder and CEO of Church's Fried Chicken, to an internationally recognized conservationist. In fact, Greene tells two integrally related stories: the evolution of one man's business sense, applying profit incentives to land restoration and nature conservancy; and the creation of a Texas Hill Country preserve where he effectively demonstrates his own principles. It is one of the Texas Hill Country's greatest conservation success stories.

Bamberger bought what he describes as the sorriest piece of land in Blanco County and entered upon a decades-long effort to restore the ecological balance of 5,500 acres that had been virtually destroyed by more than a century of misuse. Naming his preserve Selah, from the Old Testament term meaning "pause and reflect", Bamberger dedicates himself and his resources to protecting species and educating school children, conservation groups, government officials, and everyone else who will listen to his central message, delivered with evangelical zeal: We must take care of the earth, and anyone can help.

Today, David and his wife, Margaret, have received many awards, and he has been featured in *The New Yorker*, in *Audubon*, and on CNN and network news. But until now, no one has fully told the story of how a man with vision transformed a place--and in doing so, transformed himself.

Jeffrey Greene is also the author of the memoir *French Spirits* and three collections of poetry. The book includes illustrations, a bibliography and index. It would be a valuable addition to any public or college library.—*Gary L. Jennings, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

SENECIO CYMBALARIOIDES, *S. SUBNUDUS*, AND *S. SUBPELTATUS*, HISTORY OF A MUDDLE (ASTERACEAE: SENECIONEAE)

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ABSTRACT

An attempt is made to disentangle the history and present applications of the combinations *Senecio cymbalarioides, S. subnudus,* and *S. subpeltatus* (Asteraceae: Senecioneae), all three consisting of pairs of homonyms. The ensuing confusion was exacerbated by further errors, misinterpretations, and elucidations in the nomenclatural rules and is briefly sketched here. The South African *S. subnudus* DC. is lectotypified.

RESUMEN

Se realiza un intento de esclarecer la historia y aplicaciones presentes de las combinaciones *Senecio cymbalarioides, S. subnudus,* y *S. subpeltatus* (Asteraceae: Senecioneae), siendo todas ellas pares de homónimos. la consiguiente confusión fue exacerbada con otros errores, las malinterpretaciones, y elucidaciones de las reglas nomenclaturales son esbozadas brevemente aquí. Se lectotipifica el surafricano *S. subnudus* DC.

INTRODUCTION

Senecio L. is a cosmopolitan genus with 1500+ species. Morphological research in the past and in present molecular analyses indicate that it is polyphyletic and that it should be broken up in numerous smaller genera. As this is a nomenclatural exercise I here give what I think are the correct names in *Senecio* and its split-offs whenever possible. According to the present insights *Packera* Á. & D. Löve and *Roldana* La Llave are "good" genera.

In his revision of the Compositae in the Great Prodromus De Candolle (1838) used the combination *Senecio subnudus* twice, once for a species from South Africa (p. 405, # 381), and again for one from the United States (p. 428, # 522). The first to choose between the two was Buek (1840), closely followed by Steudel (1841). Unfortunately, the first maintained # 381 and renamed # 522, while the second did it the other way around.

Apparently, it is not generally known that Buek made an index to the Prodromus, and, moreover, most are not aware that when De Candolle's treatment was based on specimen(s) in G-DC there are IDC microfiches with photographs of the specimen(s), arranged according to volume, page, and species number.

Senecio subnudus DC. (# 381) — Senecio oxyriifolius DC.

Senecio subnudus DC., Prodr. 6:405. 1837 [publ.1838], # 381, non p. 428, # 522. *Senecio subpeltatus* Steud., Nomencl. ed. 2, 2:565. 1841 (nom. superfl.). TYPE: AFRICA CAPENSIS. DISTR. STELLENBOSCH: *Ecklon 787.56.8 A° 1835* (LECTOTYPE, designated here: HOLOTYPE: G-DC; IDC MICROFICHE 800).

= *Senecio oxyriifolius* DC., Prodr. 6:405. 1837 [publ. 1838], # 379 ('*oxyriaefolius*').

Harvey (1865) was the first to include the equally old *Senecio peltatus* DC., *S. subnudus* DC. (# 381), and *S. peltiformis* DC. in *S. oxyriifolius* DC. (see Stearn 1955), and if this merge is accepted, the latter is the correct name in *Senecio* L. The species is part of a clade of South African and Madagascan succulents of the 'Gynuroid' group, and will have to be transferred to another or even a new genus (P. Pelser, pers. comm.).

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Senecio subnudus DC. (# 522), Senecio cymbalarioides H. Buek — Packera subnuda (DC.) Trock & T.M. Barkley

Senecio subnudus DC., Prodr. 6:428. 1837 [publ. 1838], # 522, non p. 405, # 381. Steud., Nomencl., ed. 2, 2:565. 1841. *Senecio cymbalarioides* H. Buek, Gen. Sp. Synon. Cand. 2:vi. 1840, nom. nov. *Senecio aureus* L. var. *subnudus* A. Gray, Syn. Fl. N. Amer. 1, 2:391. 1884. *Senecio pauciflorus* Pursh var. *subnudus* Jeps., Man. Fl. Pl. Calif. 1154. 1925. *Packera cymbalarioides* W.A. Weber & Á. Löve in W.A. Weber, Phytologia 55:9. 1984, non W.A. Weber and Á. Löve (1981). *Packera buekii* Trock & T.M. Barkley, Sida 18:387. 1998, nom. superfl., see note. *Packera subnuda* Trock & T.M. Barkley, Sida 18:635. 1999. Type: AMERICAN WEST COAST: Columbia River, *Douglas A° 1830* (holotype: G-DC; IDC microfiche 800), 'ab hon. Soc. Hortic. Lond.' (This herbarium was broken up in auctions between 1856 and 1859. I do not know where the Asteraceae went. There is a possible duplicate in K "ex Herb. Benth." with a printed label, not handwritten as in G-DC. It is not impossible that when material was selected to be sent to De Candolle there was only a single printed label, so a handwritten copy had to be made).

= *Senecio cymbalarioides* H. Buek. or *Packera subnuda* (DC.) Trock & T.M. Barkley.

The status of the rejected name *S. subnudus* DC. # 522 has been clarified by the addition of Note 3 to Art. 53.6 in the ICBN (2006):

> Art. 53.6. When two or more homonyms have equal priority, the first of them that is adopted in an effectively published text (Art. 29, 30, 31) by an author who simultaneously rejects the other(s) is treated as having priority. Likewise, if an author in an effectively published text substitutes other names for all but one of these homonyms, the homonym for the taxon that is not renamed is treated as having priority.
>
> *Note* 3. A homonym renamed or rejected under Art. 53.6 remains legitimate and takes precedence over a later synonym of the same rank, should a transfer to another genus ... be effected.
>
> *Ex. 20. Mimosa cineraria* L. (1759), based on *M. cinerea* L. (Sp. Pl. 517, non 520. 1753; see Art. 53 Ex. 18), was transferred to *Prosopis* by Druce (1914) as *P. cineraria* (L.) Druce. However, the correct name in *Prosopis* would have been a combination based on *M. cinerea* had not that name been successfully proposed for rejection.

According to Trock and Barkley (1998) followed by Trock (2006) *S. subnudus* DC. # 522 belongs to *Packera* Á. & D. Löve. Trock and Barkley (1998) had called it *P. buekii* which is superfluous as they should have used the epithet *subnuda* under Note 3 above. They corrected this a year later (1999) to *Packera subnuda* (DC.) Trock & T.M. Barkley.

Senecio subpeltatus Sch.-Bip. — Roldana subpeltata H. Rob. & Brettell

The second author to coin the combination *Senecio subpeltatus* was Schultz "Bipontinus" (1856) for a Mexican species. This is a later homonym of the one by Steudel (1841). Curiously, no one seems to have picked this up and proposed an alternative name in *Senecio* for it. When transferred to *Roldana* it is to be cited as *Roldana subpeltata* H. Rob. & Brettell (Art. 58.1), without bracketed authorship, i.e., not as [Sch.-Bip.] H. Rob. & Brettell.

In older Codes "square-bracketed authorship" was used to indicate that there was something "wrong" with the basionym, e.g. based on a pre-Linnaean one, or on an invalid or illegitimate base. Unfortunately, this useful application has quietly vanished after the Edinburgh Code (1966). The reference was still given in the index of the Seattle Code (1972), but not in the text.

Senecio subpeltatus Sch.-Bip., in Seem., Bot. Voy. Herald 311. 1856, non Steud. (1841). *Roldana subpeltata* H. Rob. & Brettell, Phytologia 27:424. 1974. Type: MEXICO: Sierra Madre, *Seemann 1984* (holotype: BM; isotype: K, P, F-photo, GH).

= *Roldana subpeltata* H. Rob. & Brettell

Dr. A.M. Funston (in sched.) regarded the K collection as the lectotype, but Seemann's "study set" for the Herald voyage is in BM (Stafleu & Cowan 1985: 474) and the holotype should be there.

Senecio cymbalarioides Nutt., non H. Buek

Senecio cymbalarioides Nutt., Trans. Amer. Phil. Soc. II, 7:412. 1841, non H. Buek (1840). *Packera cymbalarioides* W.A. Weber & Á. Löve, Phytologia 49:46. 1981. Type: U.S.A. Oregon: *Nuttall s.n.* (holotype: BM).

The situation has become more complicated and confusing because Weber and Löve made the combination *Packera cymbalarioides* twice: once in 1981 based on Nuttall (1841), and again in 1984, based on Buek

(1840). The latter one is therefore a later homonym of the first one, and not an isonym, as was implicitedly suggested by Weber and Löve (1984), who apparently thought that the same taxon was involved and that merely changing the bracketed author would 'correct' their earlier combination.

In *Senecio* the correct name is ***Senecio streptanthifolius*** Greene according to Cronquist [(1994: 184), with extensive synonymy]. If it is a *Packera* the name is ***Packera streptanthifolia*** (Greene) W.A. Weber & Á. Löve (1981: 48), see Trock (2006: 599) who did not accept the varieties distinguished by Bain (1988).

Senecio cymbalarioides subsp. moresbiensis Calder & R.L. Taylor

Senecio cymbalarioides (author not given; H. Buek, see below) subsp. **moresbiensis** Calder & R.L. Taylor, Canad. J. Bot. 43:1399. 1965. *Senecio streptanthifolius* Greene var. *moresbiensis* (Calder & R.L. Taylor) B. Boivin, Naturaliste Canad. 93:1051. 1966, nom. inval., see note. *Senecio resedifolius* Less. var. *moresbiensis* (Calder & R.L. Taylor) B. Boivin, Phytologia 23 (1972) 108. *Senecio moresbiensis* (Calder & R.L. Taylor) G.W. Douglas & Ruyle-Dougl., Canad. J. Bot. 56:1710. 1978. *Packera moresbiensis* (Calder & R.L. Taylor) J.F. Bain, Novon 9:457. 1999. *Packera subnuda* (DC.) Trock & T.M. Barkley var. *moresbiensis* (Calder & R.L. Taylor) Trock, Sida 21:289. 2004. Type: CANADA. British Columbia: Moresby Isl., Takakia lake, *Calder, Saville & Taylor 23066* (holotype: DAO).

The authorship of the specific combination was not given by Calder & Taylor. In 1968 they cited Nuttall as the author, but Taylor (1978) said that Buek had been intended. I suspect she fell in the same trap as Weber & Löve previously did.

Boivin made the combination *Senecio streptanthifolius* Greene var. *moresbiensis* B. Boivin, which is invalid, as it lacked a full and direct reference to the basionym. Since in *Senecio* this seems to be the name required at the varietal level, the necessary combination needs to be validated. As a species it is ***Senecio moresbiensis*** (Calder & R.L. Taylor) G.W. Douglas & Ruyle-Dougl.

In *Packera* the correct name is ***Packera subnuda*** (DC.) Trock & T.M. Barkley var. ***moresbiensis*** (Calder & R.L. Taylor) Trock or ***Packera moresbiensis*** (Calder & R.L. Taylor) J.F. Bain. Trock (2004: 289) opted to recognise the varietal status. That in Trock (2006) *Packera streptanthifolia* is followed by *Packera subnuda* is not indicative of any other relationship than an alphabetical one.

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I want to thank C. Flann (WAG) for pointing out the problem, P.B. Pelser (MU) for his comments on *S. subnudus DC. #381*, D.G. Frodin (K) for the information on the 19th century herbarium of the Royal Horticultural Society, D.J.N. Hind (K) for finding a possible isotype of *Senecio subnudus* DC. in K, T.S. Quedensley (TEX) for information on *Roldana subpeltata*, and D.K. Trock (CAS-DS) and G. Nesom (BRIT) for their critical reviews. The resumen was made by R. Camara Loret, Leiden.

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2C DNA CONTENT VALUES IN *AMARANTHUS* (AMARANTHACEAE)

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ABSTRACT

Feulgen densitometry was used to measure 2C DNA content values from 15 accessions of 12 species of *Amaranthus* representing all subgenera. Species showed a 3-fold variation in range from 0.89 pg (*Amaranthus viridis*) to 2.73 pg (*Amaranthus tricolor*). Values are compared to previous reports and taxonomic implications of DNA content values are discussed.

RESUMEN

Se usó la densitometría de Feulgen para medir los valores del contenido de 2C DNA de 15 accesiones de 12 especies de *Amaranthus* que representan todos los subgéneros. Las especies mostraron una variación de 3-veces variando de 0.89 pg (*Amaranthus viridis*) a 2.73 pg (*Amaranthus tricolor*). Se comparan los valores con informes previos y se discuten las implicaciones taxonómicas de los valores de contenido de DNA.

INTRODUCTION

Amaranthus L. (Amaranthaceae) is a genus of about 70 species of monoecious or dioecious annuals of worldwide distribution. The genus is economically important, including the cultivated grain amaranths, potherbs, and ornamentals as well as a suite of agricultural and range weeds. Traditionally the genus has been divided into two subgenera, subg. *Amaranthus* (the monoecious amaranths) and *Acnida* (dioecious amaranths) based on breeding system (Robertson 1981). The most recent classification system divides *Amaranthus* into three subgenera: *Amaranthus* (with 12 species), *Acnida* (with 9 species), and *Albersia* (with 49 species) based on breeding system and characteristics of the fruit and flowers (Mosyakin & Robertson 1996).

Chromosome counts of the Amaranthaceae reveal a base count of $x = 8$ or $x = 9$ (Turner 1994). *Amaranthus* itself appears to be paleopolyploid with counts of $n = 16$ or $n = 17$ (Grant 1959a; Grant 1959c; Greizerstein & Poggio 1992; Greizerstein & Poggio 1994), and genomes behave as diploids during meiosis with the exception of *Amaranthus dubius*, an allotetraploid with $n = 32$ between *A. spinosus* and an unknown species (Grant 1959b; Greizerstein & Poggio 1992). Cytogenetic research demonstrated that variation between $n =16$ and $n =17$ can occur within individuals of a single population, the extra chromosome in individuals with counts of $n = 17$ is derived via primary trisomy from $n = 16$ (Pal et al. 1982; Griezerstein & Poggio 1994). In addition to chromosome number, karyotypic work has demonstrated that *Amaranthus* chromosomes are of small size (Grant 1959a; Grant 1959c; Griezerstein & Poggio 1994); possess a single NOR locus (Griezerstein & Poggio 1994); and demonstrate a wide variety of C banding patterns putatively due to differences in heterochromatin content (Griezerstein & Poggio 1994).

Aside from chromosome counts, very little research has been directed towards analysis of DNA content in *Amaranthus*. To date, 2C DNA content in picograms has been recorded for 14 species in *Amaranthus* (Griezerstein & Poggio 1994; Bennett et al. 2000; Jeschke et al. 2003; Rayburn et al. 2005). Taxonomic sampling of the DNA content studies is highly skewed. Of the 14 reported counts, nine reports come from the weedy and cultivated species of subgenus *Amaranthus* (which contains an estimated 12 species), two reports from subg. *Acnida* (which contains nine species), and three reports from subg. *Albersia* (which contains 49 species). However, given the wide range of previously reported DNA content values, it would be prudent to expand sampling of subg. *Acnida* and *Albersia*.

The objectives of this study were therefore twofold: 1) to obtain estimates of DNA content from a wide variety of species of *Amaranthus* including representatives of all three subgenera using an image analysis densitometry technique; and, 2) to explore possible taxonomic significance of DNA content variation.

MATERIALS AND METHODS

Seed from fifteen accessions and twelve species of *Amaranthus* were donated by the USDA North Central Regional Plant Introduction States (NCRPIS). Known 2C DNA values for *Amaranthus* were obtained from the database at Kew Gardens (data.kew.org/cvalues/), and *Sorghum bicolor* Pioneer cultivar 8695 was chosen as the reference standard based on its 2C DNA content of 1.74 pg (Johnston et al. 1999) which compared favorably to the range of values (0.96–2.46 pg) reported in the Kew database.

Amaranth seeds were stratified at 4°C for one month and plants grown in a greenhouse. Roots were fixed in 3:1 ethanol: glacial acetic acid solution and stored in 70% ethanol at 4°C. Fixed root material was hydrolyzed in 5N HCl for 30 minutes and stained in freshly prepared and charcoal-filtered Fuelgen stain for three hours, and destained for 15 minutes in distilled water. Fuelgen stained roots tips were softened 45 minutes in 2% w/v cellulysin enzyme in 0.001 M EDTA pH 5.6 solution, replaced with 45% acetic acid, squashed, cryofixed in liquid nitrogen, and dried overnight before adding coverslips.

Chromosome squashes were photographed on an Olympus BX50 Light Microscope using a Nikon UR-E6 Coolpix MDC Lens attached to a Nikon Coolpix 5000 digital camera. Twenty to thirty images of the stained nuclei per specimen were uploaded, analyzed using a wavelength of 560 nm (Hardie et al. 2002), and integrated optical density (I.O.D.) values were calculated using Image Pro Plus 5.1 (Media Cybernetics, Inc., Maryland).

IOD values for nuclei were pooled after discarding the top and bottom 5% of values if an ANOVA indicated no difference between the means from different images (Hardie et al., 2002), and mean IOD values were calculated from the pooled data. A coefficient of variation (COV) was calculated (mean / stdev.) and the IOD data was considered usable only if the COV was less than 10% (Vilhar et al. 2001; Hardie et al. 2002). Absolute DNA contents in picograms for all *Amaranthus* populations were determined comparing the mean IOD values to the mean IOD for *S. bicolor* standard that was processed in the same stain batch as the *Amaranthus* spp using the following calculation: $[{}^{\text{Amaranth IOD}}/_{\text{Sorghum IOD}}]*1.74$ pg

RESULTS

Mean 2C DNA content values are reported in Table 1. Among the fifteen accessions sampled we found 3-fold variation in 2C DNA contents, ranging from a low of 0.89 pg in *A. viridis* to a high of 2.73 in *A. tricolor*. The two subspecies of *A. graecizans* had a 1.1-fold difference in values (1.33 and 1.46). The two accessions of *A. arenicola* had 1.31 fold difference in content values (1.15 and 1.5). The two accessions of *A. blitum* had a 1.14-fold range in content values (1.06 and 1.21). Subgenera *Acnida* and *Albersia* showed a 1.14 and 1.07-fold increase in DNA content values over values found in subgenus *Amaranthus*. Within subg. *Albersia*, section *Pyxidium* showed a 1.8-fold increase in DNA values over sections *Blitopsis* and *Pentamorion*.

DISCUSSION

We report 2C DNA content values from 15 accessions of 12 species (Table 1), and provide reports for eight species and two sections (*Blitopsis* and *Pentamorion*) that had previously been unreported in the literature (Table 2), expanding the sampling from *Amaranthus* to 23 species. Our values compare favorably to previously reported values (Table 2).

Table 1. List of sampled accessions, species, and 2C DNA content values.

Taxon	Location	Accession	2C
Subgenus *Amaranthus*			1.23
A. caudatus	Peru	PI 490440	1.32
A. dubius	Panama	Ames 25792	1.23
A. powellii bouchonii	Germany	PI 572261	1.13
Subgenus *Acnida*			1.40
A. arenicola	Kansas	PI 607459	1.51
A. arenicola	Kansas	PI 599671	1.15
A. greggii	Texas	PI 632240	1.54
Subgenus *Albersia*			1.32
Sect. *Blitopsis*			1.02
A. acutilobus	Germany	PI 633578	1.22
A. blitum	India	PI 608661	1.06
A. blitum	India	PI 610262	1.21
A. viridis	Maldives	PI 536439	0.89
Sect. *Pyxidium*			1.84
A. tricolor	Pennsylvania	PI 599683	2.73
A. graecizans silvestris	India	Ames 24671	1.46
A. graecizans thellungianus	Mauritius	PI 549157	1.33
Sect. *Pentamorion*			1.01
A. crassipes	Cuba	Ames 10339	0.97
A. standleyanus	Argentina	PI 61380	1.02

Values from subg. *Amaranthus* range from 1.04 pg in *A. hybridus* to 1.9 pg in *A. spinosus* with a composite average (our values as well as all other reported values) of 1.29 pg (Table 2). Two of the reported values, *A. retroflexus* 1.7 pg and *A. spinosus* 1.9 pg, are suspiciously high (1.31 and 1.4-fold higher than the average) compared to other reported values for these species and for other member of subg. *Amaranthus* (Table 2). If these two values are removed, the range of values for the subgenus decreases to 1.04–1.35 pg, with a composite average of 1.23 pg which matches our values closely (Table 2).

Several DNA content values from subg. *Amaranthus* are noteworthy. The 1.23 pg DNA content for the allotetraploid *A. dubius* is particularly intriguing (Table 1). The most likely 2C DNA content value of the known parental species, the diploid *A. spinosus*, is 1.10 pg (Table 2). If these values for *A. dubius* and *A. spinosus* are correct, then either the DNA content of *A. dubius* has undergone a major contraction following the polyploidization event, or the unknown parent has a very small genome size. The reported values for *A. hybridus* and *A. quitensis* (a South American form of *A. hybridus*) range from 1.04 to 1.30 pg, with an average of 1.18 pg. This species is a wide-ranging, cosmopolitan weed that originated in the Americas. The range in values may represent geographic or taxonomic patterns of distribution that should be better examined.

Reported values from subg. *Acnida* (the dioecious amaranths) represent a 1.62-fold range from 0.95 to 1.54 pg in DNA content (Table 2). This subgenus is closely related to species of Subg. *Amaranthus* as determined by crossing data (Murray 1940; Trucco 2006). The large range of reported values may represent considerable changes in DNA content following the evolution of dioecy. There is a 1.3 fold difference in 2C DNA content values for *A. arenicola*. The accessions were collected from the Arkansas River in Kansas two years apart by different collectors. *Amaranthus arenicola* is a wild species endemic to the area, and has received little study. These data indicate the possibility that the area may be a center of diversity for the species and further research into the species is warranted. The reported DNA content value for *A. palmeri*

TABLE 2. DNA content values from current research and literature review.

	Our Value	Literature
Subgenus *Amaranthus*		
A. caudatus	1.32	1.30[1]
		1.35[2]
		1.26[5]
A. cruentus		1.30[1]
		1.26[2]
A. dubius	1.23	
A. hybridus		1.30[1]
		1.04[2]
A. hypochondriacus		1.30[1]
		1.26[2]
A. powellii powellii		1.20[1]
		1.14[3]
A. powellii bouchonii	1.13	1.20[4]
A. quitensis		1.20[1]
A. retroflexus		1.70[1]
		1.23[3]
A. spinosus		1.90[1]
		1.10[3]
Average values	1.23	1.30
Composite average	1.29	
Subgenus *Acnida*		
A. arenicola	1.51	
	1.15	
A. greggii	1.54	
A. palmeri		0.95[3]
A. tuberculatus		1.34[3]
Average values	1.40	1.14
Composite average	1.30	

	Our Value	Literature
Subgenus *Albersia*		
Sect. *Blitopsis*		
A. acutilobus	1.22	
A. blitum	1.06	
A. blitum	1.21	
A. viridis	0.89	
Average values	1.02	na
Composite average	1.02	
Sect. *Pyxidium*		
A. albus		1.18[4]
A. blitoides		1.15[4]
A. tricolor	2.73	1.80[1]
	2.46[5]	
A. graecizans silvestris	1.46	
A. graecizans thellungianus	1.33	
Average values	1.84	1.65
Composite average	1.73	
Sect. *Pentamorion*		
A. crassipes	0.97	
A. standleyanus	1.02	
Average values	1.01	na
Composite average	1.01	

[1] Bennett, Bhandol, & Leitch 2000
[2] Greizerstein & Poggio 1994
[3] Jeschke, Tranel, & Rayburn 2003
[4] Rayburn et al. 2005
[5] RGB Kew Gardens DNA C-Values Database

(0.95 pg, Table 2) is very low compared to other dioecious waterhemps, but is in-line with recorded values for *A. spinosus* (1.10 pg, Table 2). These DNA content values support Wassom and Tranel's (2005) AFLP data, which placed *A. palmeri* in a clade with *A. spinosus* rather than with other dioecious amaranths.

We provide DNA content data for six new species and eight accessions from subg. *Albersia* (Table 2). *Albersia* is the largest subgenus of *Amaranthus*, although most of the species are poorly known (Mosyakin and Robertson 1996). DNA content values in the subgenus ranged from the smallest value (*A. viridis* with 0.89 pg) to the largest (*A. tricolor* with 2.73 pg) in the study (Table 2) indicating that there is a great deal of variation in DNA content values within the subgenus. Values within sections *Blitopsis* (1.02 pg) and *Pentamorion* (1.01 pg) represent the lowest values in the study (Table 2). Values within section *Pyxidium* are highly variable, ranging from 1.15 pg for *A. albus* and 2.73 pg for *A. tricolor*, a 2.4 fold range of DNA contents. This is not surprising as Mosyakin and Robertson (1996) report that the section was morphologically and phytogeographically "unsatisfactory," and state that it could probably be further divided into subsections, a conclusion that might be supported by DNA content values.

Accessions of three species (*A. albus, A. blitum, and A. powellii powellii*) were sampled, but DNA contents could not be reliably quantified due to the presence of abnormally large, darkly stained nuclei that were present, side by side with nuclei of normal appearance. These large nuclei are most likely attributable to endopolyploidy, a condition that is frequent in *Chenopodium* and *Amaranthus* seedlings (Bozena Kolano, pers. comm., manuscript in preparation).

To date, differences in genome size have been used to identify hybrid individuals (Trucco et al. 2005; Trucco et al. 2006). In addition to increasing reported DNA content values within *Amaranthus* by eight additional species, we observed that patterns in DNA content might be taxonomically informative both within and among species (Table 2). Additionally we note the contraction of the genome following polyploidization in *A. dubius* and the presence of endopolyploidy in *Amaranthus*.

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BOOK REVIEW

Sara E. Jensen and Guy R. McPherson. 2008. **Living with Fire: Fire Ecology and Policy for the Twenty-first Century.** (ISBN-10 0520255895; ISBN-13 978-0520255890, hbk.). University of California Press, Berkeley and Los Angeles, California, U.S.A. (**Orders:** www.ucpress.edu, orders@cpfsinc.com, The University of California Press, c/o California/Princeton Fulfillment Services, 1445 Lower Ferry Road, Ewing, New Jersey 08618, U.S.A., Fax: 1-800-999-1958, Overseas Fax: 1-609-883-7413, Phone: 1-800-777-4726). $29.95, 192 pp., 8.3" × 5.5".

The authors look at how the ancient regime of wildfire in North America has played a role in shaping both nature and human habitat. McPherson and Jensen detail how fire has shaped North American ecosystems, but also how it threatens human lives and property. They explore the dilemma of fire through fire policy, fire science and fire management and suggest ways to address these issues.

The first chapter is entitled "Wildland fire in the West: the Big Picture" and explores how many Native American cultures were frequent burners, including early white settlers. The use of fire was abandoned in favor of aggressive fire suppression after the great fires in Idaho in 1910, and the recent Yellowstone fires only reinforced this concept amongst Washington policy-makers. "Fanning the Flames: Human Influences on Fire Regimes" looks at how changing and expanding human activities are shaping the way fires begin and develop once started. Fuel buildup often plays a minor role in the spread of economically destructive fires compared with the roles of weather and poorly devised developments in the wildland-urban interface. "The Failed State of Fire Suppression" explores the national policies that have failed to recognize that fire is necessary for the maintenance of many ecosystems and that fires cannot always be extinguished or prevented. "Logging the Forests to Save Them" shows how the Healthy Forests Initiative policies and practices have produced negative ecological and political effects instead of the intended result. It has promoted overly general management of very complex and unpredictable ecosystems, encouraged continued development in fire-prone areas, and undermined citizen participation in democratic decision-making. Public lands management should give up the idea of creating fireproof forests and focus instead on conserving wildland ecosystems. "Tools for Living with Fire" provides evidence for the proposition espoused in the previous chapter and for the idea that fire itself is the most efficient and effective tool for managing most fire-prone ecosystems. Fire management is strongly influenced by fuel management, but both are also affected by ignition sources, land use, species composition, and weather and climate patterns. The last chapter, "Policy Solutions" states that a national-level fire policy should be the first step in reworking fire-management practices. This should be followed by bringing budget allocation and staffing in line with the stated policy priorities. Lastly, the national fire policy must have a clear and effective mechanism for placing local fire-management decisions in the hands of local managers and citizens.

The book is geared primarily to help scientists, policy makers and the general public, especially residents of fire-prone areas, to understand the history of fire and how to cope with it. The authors offer abundant historical and analytic information to shed new light on current controversies. *Living with Fire* also presents ways for dealing with fire that recognizes its role in the environment, and how to rebuild important ecological and political processes to manage fire and other complex policy dilemmas.

Highly recommended for large public libraries, smaller libraries with an interest in fire management, colleges and universities with programs in forest ecology or fire management, and all others with an interest in forest ecology or fire management.

From the publisher—"**Sara E. Jensen** is Private Lands Conservation Associate with Defenders of Wildlife. **Guy R. McPherson,** Professor of Natural Resources and Ecology and Evolutionary Biology at the University of Arizona, is author of Applied Ecology and Natural Resource Management among other books."—*Gary L. Jennings, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

MINUARTIA MACRANTHA (ALSINOIDEAE: CARYOPHYLLACEAE): MORPHOLOGICAL CIRCUMSCRIPTION, GEOGRAPHICAL RANGE, AND PHYLOGENETIC AFFINITIES

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ABSTRACT

Minuartia macrantha is here defined to include *M. filiorum*. The traditional morphological distinctions between the two reputed taxa are discussed. Previously, *M. macrantha* was considered endemic to Colorado; now its geographical range is much expanded. *Minuartia filiorum* (= *M. macrantha*) is not closely related to *M. rubella*, contrary to a recent floristic treatment which recognized it as a variety of the latter. *Minuartia macrantha* is considered a southern counterpart of the *M. rossii-stricta* complex. This alliance includes the northern Rocky Mountain *M. austromontana*, recently found sympatric with *M. macrantha* in northwest Wyoming. *Minuartia stricta* is discussed briefly as it is often confused with *M. macrantha* in Colorado.

RESUMEN

Se define aquí *Minuartia macrantha* para que incluya *M. filiorum*. Se discuten las diferencias morfológicas tradicionales entre los dos supuestos taxa. Previamente, *M. macrantha* fue considerada endémica de Colorado; ahora su rango geográfico se ha expandido mucho. *Minuartia filiorum* (= *M. macrantha*) no está cercanamente relacionada con *M. rubella*, contrariamente a un reciente tratamiento florístico que la reconoce como variedad de esta última. *Minuartia macrantha* se considera una equivalente sureña del complejo *M. rossii-stricta*. Esta alianza incluye la norteña de las Montañas Rocosas *M. austromontana*, encontrada recientemente como simpátrica con *M. macrantha* en el noroeste de Wyoming. *Minuartia stricta* se discute brevemente ya que se confunde frecuentemente con *M. macrantha* en Colorado.

Our intent is to elaborate on the morphology of *Micrantha macrantha* s.l. (including *M. filiorum*), and the degree of variability of diagnostic characters. Furthermore, the marked change in geographical range is documented (see specimens cited and Fig. 1). Finally, the presumed phylogenetic affinities of *M. macrantha* are discussed.

Bassett Maguire is recognized for his superb taxonomic treatments of *Arenaria*, including currently recognized segregate genera (*Eremogone, Honckenya, Minuartia*, and *Moehringia*), in North America and his collaboration with C. L. Hitchcock on *Silene*. Subsequent to Maguire's work, Stanley L. Welsh and associates at Brigham Young University obtained numerous collections from Utah and vicinity that were determined as *M. filiorum*. Correspondingly, floristic studies in Colorado and Wyoming (COLO, RM) contributed a wealth of material, chiefly from these core southern Rocky Mountain states, that were determined as *M. macrantha*. Unfortunately, there was relatively little communication between these two areas, although a number of duplicates were exchanged. When we examined these collections during the preparation of the treatment of *Minuartia* for the *Flora of North America* (Rabeler et al. 2005), we found the specimens filed as *M. macrantha* and *M. filiorum* to be more difficult to segregate than the literature suggested.

MORPHOLOGY

Maguire (1946) described *Minuartia filiorum* and later (1958) distinguished it from *M. macrantha* (both under *Arenaria*) on the basis of habit (annual or weakly perennial vs. obviously perennial with numerous procumbent stems to 10 cm), cymes (1–5- vs. 3(–5)-flowered), flowers (not showy vs. large and showy), sepal length and shape (3.5–4.8 mm, ovate-lanceolate vs. 4.5–5 mm, broadly lanceolate), and petal to sepal ratios (shorter than to equaling sepals vs. conspicuous, exceeding them, to 8 mm long, respectively). While

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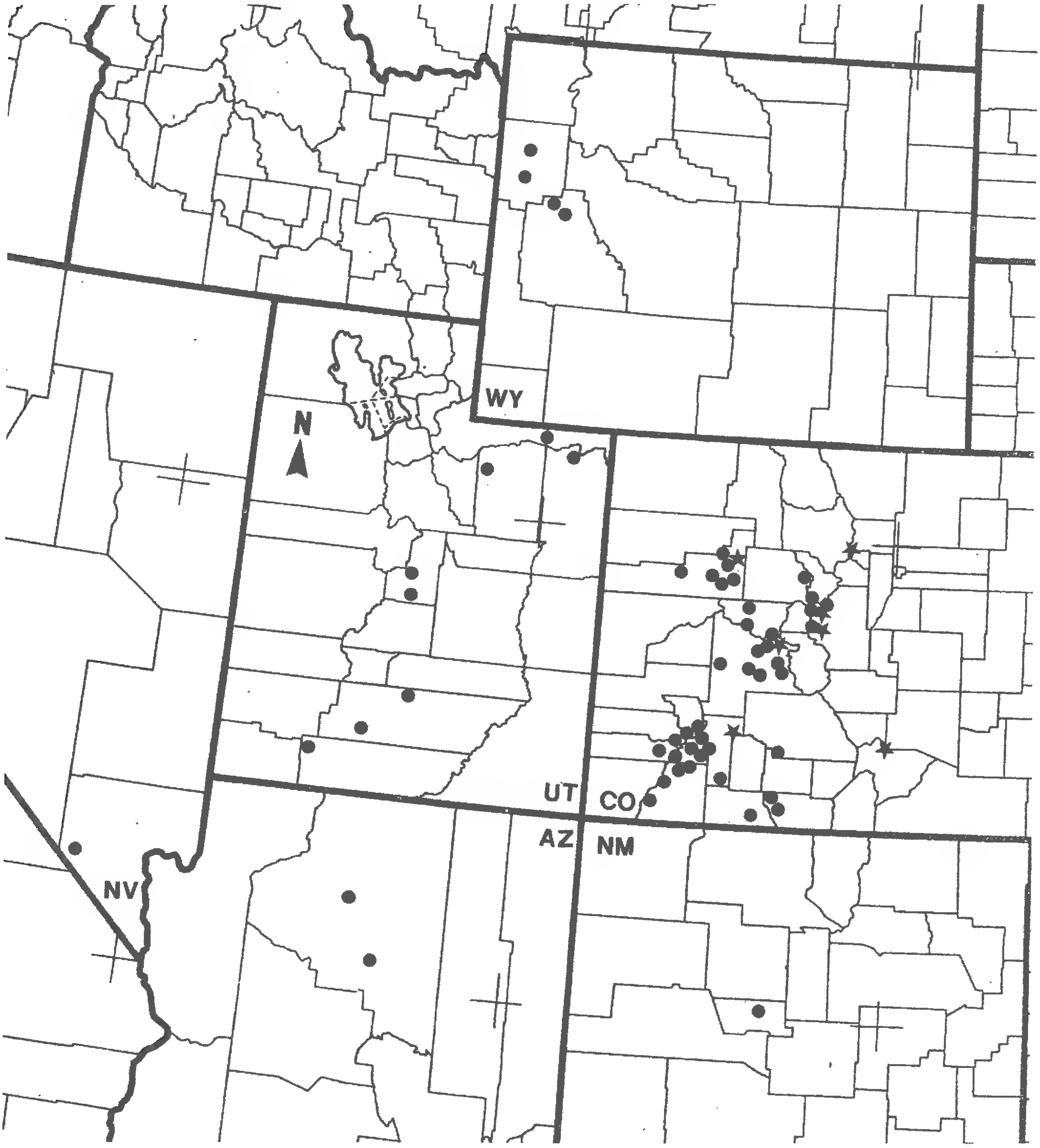

Fig. 1. Map of the southern Rocky Mountains, U.S.A., with solid dots representing collecting sites of *Minuartia macrantha*, solid stars representing sites of *M. stricta*.

some populations may be differentiated using these features, many cannot be so recognized. For example, the number of flowers per inflorescence, the length of the petals relative to the sepals, and sepal length are more variable than portrayed. On the other hand, the mature sepals of both taxa are strongly ribbed (Fig. 2a) and the seeds are essentially identical. We concur with W.A. Weber and R. Wittmann's annotation of the holotype of *M. filiorum* (as *Alsinanthe macrantha* (Rydb.) W.A. Weber 1983) as inseparable from *M. macrantha*; our independent conclusion (Rabeler et al. 2005).

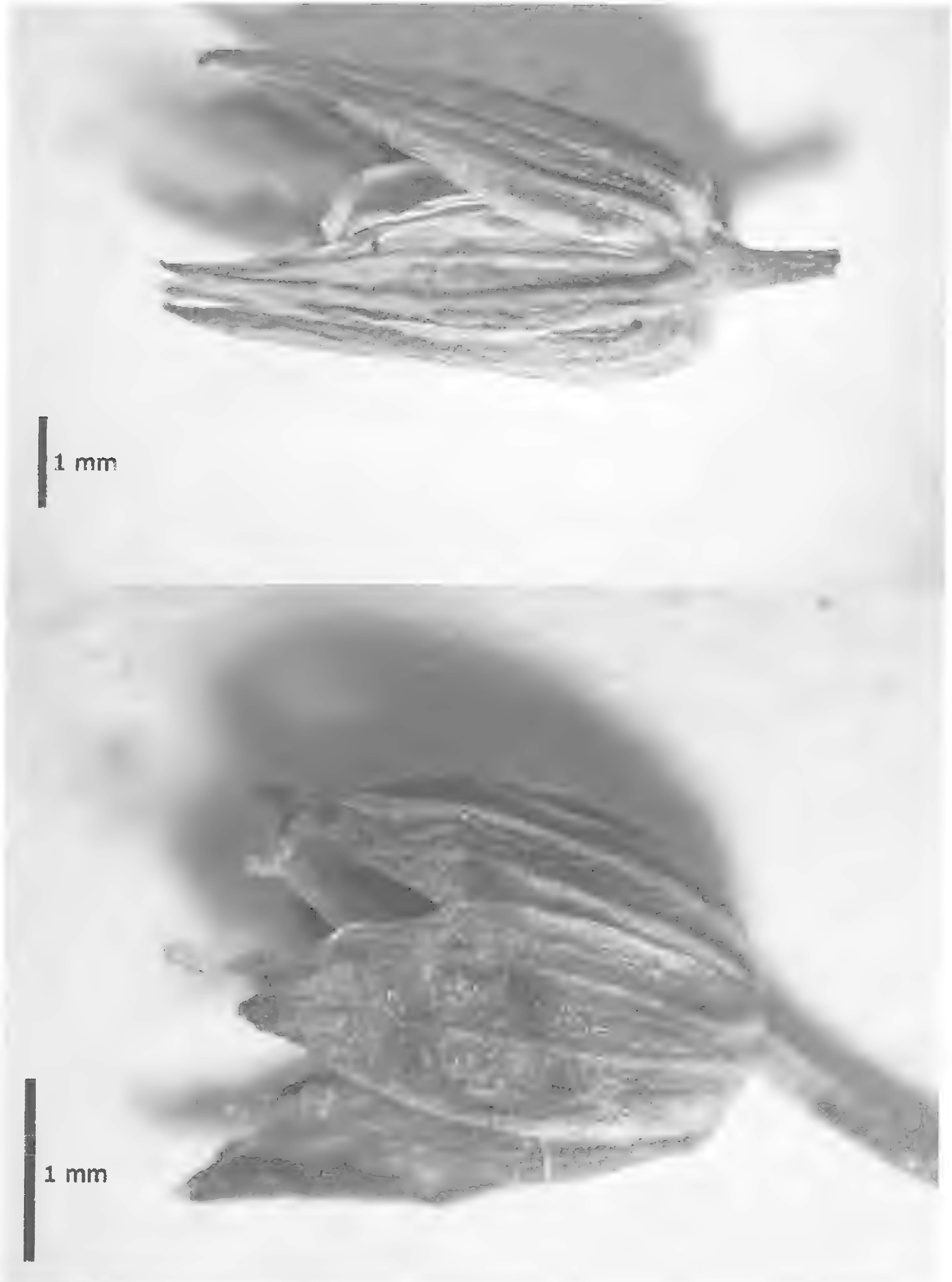

Fig 2. Photos of fruiting material of *Minuartia macrantha* at top (*Huber & Goodrich 2910*, BRY) and *M. stricta* below (*Elliott 11048a*, RM). Note scale bars, the *M. stricta* is magnified 2× relative to *M. macrantha.*

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Arenaria filiorum Maguire, Bull. Torrey Bot. Club 73:326. 1946. *Minuartia filiorum* (Maguire) McNeill, Rhodora 82:498. 1980. *Arenaria rubella* (Wahlenb.) Sm. var. *filiorum* (Maguire) S. L. Welsh, Rhodora 95:393. 1993. Type: U.S.A. Utah. Kane Co.: [Iron Co.]: Navajo Lake, [9030 ft], common, gravelly beaches, 13 Jul 1940. *B. Maguire 19472* (holotype: NY, photo!; isotype: GH, UTC, UC).

Common nanes.—House's stitchwort, large-flower sandwort, beach sandwort.

Plants perennial, cespitose or mat-forming, or sometimes annual, glabrous throughout. **Taproots** occasionally filiform, but usually somewhat thickened to moderately stout, often woody. **Stems** erect to numerous and procumbent, green, 2–20 cm long, internodes of all stems 0.3–1(–2) times leaf length. **Leaves** moderately to tightly overlapping (proximal cauline), variably spaced, progressively more so distally (distal cauline), connate proximally, with loose, scarious sheath 0.3–0.8 mm long; blade straight to slightly outcurved, green, flat to triquetrous distally, 1–3-veined, fleshy, midvein more prominent than 2 lateral veins, subulate to linear, 5–10 mm long, 0.5–1.2 mm wide, flexuous, margins not thickened, scarious, smooth, apex green, rounded, thickened and navicular, shiny; axillary leaves present among proximal cauline leaves. **Inflorescences** terminal, 2–5(–9)-flowered, open to strict cymes or more often a solitary flower; bracts broadly subulate, herbaceous or scarious-margined proximally. **Pedicels** 0.2–1.5 cm long. **Flowers** perigynous, 5-merous; hypanthium disc-shaped; sepals ovate to lanceolate (herbaceous portion lanceolate), 3.5–5.5 mm long, to 6.5 mm in fruit, margins thinly scarious (0.1–0.2 mm wide), inrolled near apex, strongly 3-ribbed, especially in fruit, rarely weakly so, ribs rounded, apex green or purple in part, blunt to sharply acute or acuminate, not hooded but often incurved; petals oblong to obovate, (0.7–)1.2–1.5(–2) times sepal length, apex rounded to blunt, entire (Fig. 2); stamens 10, those opposite the sepals with basal nectaries 0.3–0.4 mm long, 0.4–0.5 mm wide, triangular, tapering distally, each with a shallow adaxial groove, collectively with the brief hypanthium forming a nectar dish; styles 3, filiform, 1–3 mm long with stigmatic papillae capitate or nearly so. **Capsules** on stipe ca. 0.2 mm long, broadly ovoid, 3–3.8 mm long, somewhat shorter than to slightly exceeding the sepals, valves 3, recurved at apex. **Seeds** 8–13, black, suborbiculate with radicle prolonged to rounded beak, somewhat compressed, 0.7–1 mm long, tuberculate; tubercles low, rounded.

Representative specimens: Collections either cited or annotated as *Arenaria filiorum* by Maguire are indicated by an "**m**" followed by the herbarium abbreviation and literature citation where appropriate (e.g., (**m;** USFS), (**m;** NY, UTC, cited Madroño 8:262. 1946)). Up to three collections are cited per county.

UNITED STATES. ARIZONA. Coconino Co.: San Francisco Mts., 12,000 ft, 7 Aug 1938, *Little 4664A* (USFS); Kaibab Plateau, De Motte Park, 8,700 ft, 17 Jun 1977, *Reeves 5634* (ASU). **COLORADO. Archuleta Co.:** Quartz Lake trail, 6 Sep 1998, *Heil 12* (SJC). **Clear Creek Co.:** Grays Peak, Jul 1888, *Eastwood s.n.* (COLO). **Conejos Co.:** S of Blue Lake, 12,000 ft, 17 Jul 2003 *Lundquist & Rink L118* (RM). **Dolores Co.:** Navajo Basin, 11,140–12,100 ft, 26 Jul 1994, *Moore 3441* (RM); upper Fish Creek drainage S of Dolores Peak, 10,200–11,800 ft, 27 Jul 1995, *Moore 7533* (RM). **Garfield Co.:** head of East Elk Creek, Flat Tops, 10,000–10,400 ft, 24 Jul 1990, *Hartman 25915* (RM); Clinetop Mesa, 10,300–10,500 ft, 24 Jun 1990, *Hartman 25938* (RM); Indian Camp Pass, 9,800–10,000 ft, 6 Aug 1991, *Vanderhorst 3824* (RM). **Gunnison Co.:** Horse Basin, 11,600 ft, 7 Aug 1950, *Langenheim 70* (COLO); Comanche Creek, 12,000 ft, 14 Jul 1951, *Langenheim 1361* (COLO); Fossil Ridge area, 12,450 ft, 30 Jul 1989, *Lehr 1262* (COLO); Double Top Mt., 11,500–11,900 ft, 14 Jul 1997, *Taylor 3293* (RM). **Hinsdale Co.:** Graham Peak area, 10,420–11,425 ft, 11 Jul 2002, *Heil & Mietty 19182* (SJC). **Lake Co.:** Weston Pass, 12,000 ft, 14 Jul 1940, *Gierisch 1298* (USFS). **La Plata Co.:** Silver Mesa near Lake Marie, 12,200 ft, 11 Jul 1993, *Cramer 67* (COLO); Chicago Basin, 12,000 ft, 13 July 1934, *Penland 1075* (COLO); Lime Mesa, 21 Aug 1982, *Siplivinsky & Beck 4897* (COLO). **Park Co:** Weston Pass, 11,700 ft, 28 Jul 1985, *Hartman 6357* (RM); Mt. Bross, 3,500–3,900 m, 25 Jul 1982, *Weber et al. 2115* (COLO, RM); North Star Mt., 12,300 ft, 3 Jul 1954, *Weber 8751* (COLO). **Pitkin Co.:** ridge E of Avalanche Ck, 12,000 ft, 14 Jul 1952, *Langenheim 2106* (COLO). **Rio Grande Co.:** Wet Canyon, 2.6 mi NW of Elwood Pass, 10,500 ft, 24 Jul 1996, *Heil 10367* (SJC). **San Juan Co.:** near Ironton, 21–31 July 1899 *Curtis s.n.* (**m;** NY); Ruby Pass, 12,700 ft, 6 Jul 1996, *Hogan 3023b* (COLO); Stony Basin, 12,500 ft, 29 Jul 1983, *Rottman 1753* (COLO). **San Miguel Co.:** near Trout Lake, 12,000 ft, 21 Aug 1924, *Payson & Payson 4192* (RM). **NEVADA. Clark Co.:** Charleston Peak, 3,400 m, 8 Aug 1935, *Clokey 5460* (**m;** NY, UTC). **NEW MEXICO. Bernalillo Co.:** Kiwanis Point, Sandia Crest, 15 mi NE of Albuquerque, 10,000–10,200 ft, 28 Jul 1964, *Baad 1035* (MICH), 23 Jun 1976, *Wagner 2344* (MO), 22 Jul 1999, *Sivinski 4997* (RM, UNM) (see Hartman and Sivinski 2006). **UTAH. Beaver Co.:** Tushar Mts., Dugway above Big Jim Flat, 3,050–3,150 m, 27 Jul 1991, *Atwood 16176* (BRY). **Daggett Co.:** "Gates of Birch Creek," 8 mi WSW of McKinnon, Wyoming, 9,600–9,700 ft, 30 Aug 1984, *Tuhy 2176* (UTC). **Duchesne Co.:** S rim of S

Fork Rock Creek, 14 mi N of Tabonia, 10,700 ft, 29 Jul 1981, *Goodrich & Jepson 15904* (BRY, RM); S rim of S Fork Rock Creek, T2N R8W Sec. 24, 10,700 ft, 15 Aug 1995, *Huber & Goodrich 2910* (BRY); Boulder Mt., 9,800 ft, 17 Aug 1995, *Welsh & Atwood 26242* (BRY, COLO). **Garfield Co.:** T31S R3E Sec. 36, 10 Sep 1942, *Ellison 942-13* (USFS); Clinetop Mesa, 10,300–10,500 ft, 24 Jun 1990, *Hartman 25938* (RM); Boulder Mt., Pleasant Creek Meadows, 10,600–10,700 ft, 6 Aug 1996, *Huber 3415* (BRY); 2 mi N of Posey Lake, Aquarius Plateau, 10,000 ft, 29 Jun 1940, *Maguire 20105* (**m;** NY, cited Madroño 8:262. 1946). **Iron Co.:** ¼ mi E Brian Head Peak, 11,000 ft, 23 Jun 1940, *Maguire 20097* (**m;** NY, UTC); summit of Second Left Hand Canyon, Markagunt Plateau, 3,100 m, 9 Aug 1986, *Neese 17615* (**m;** BRY). **Juab Co.:** Mt. Nebo, 10,500–11,500 ft, 17 Jul 1980, *Collins & Harper 864* (BRY). **Kane Co.:** Spruce Camp, Navajo Lake, 15 Jul 1940, *Maguire 19541* (UTC). **San Pete Co.:** head of Mayfield Canyon, 10,928 ft, 8 Aug 1940, *Maguire 19988* (**m;** NY, UTC, cited Madroño 8:262. 1946); T20S R4E Sec. 19, 10,000 ft, 22 Aug 1945, *Ellison 4533* (**m;** USFS); Heliotrope Mt., 11,000 ft, 24 Jun 1977, *Lewis 4760* (BRY). **Uinta Co.:** Dyer Mine, 5 Jul 1902, *Goodding 1256* (RM). **WYOMING. Sublette Co.:** Palmer Peak, 10,600–11,400 ft, 5 Aug 1994, *Hartman 40378* (RM); Hodges Peak, 10,400–11,180 ft, 2 Aug 1994, *Hartman 49240* (RM). **Teton Co.:** Moose Basin divide, 9,140 ft, 22 Aug 2007, *Scott & Varga 5711a* (RM); Mount Hunt divide, 9,700 ft, 4 Aug 2004, *Varga et al. s.n.* (Grand Teton National Park).

GEOGRAPHIC RANGE, ECOLOGY, AND PHENOLOGY

Prior to Rabeler et al. (2005) and Hartman and Sivinski (2006), the published geographical range of *M. macrantha* s.str. was Colorado while *M. filiorium* was credited to the southern portions of Colorado, Utah, and Nevada (Maguire 1946, 1958). Based on recent collections and annotations, *M. macrantha* s.l. is now known to occur throughout western Colorado, from northeast to southwest Utah, at one location in southern Nevada, and most recently in restricted areas of central Arizona, central New Mexico, and northwest Wyoming (see specimen citations and Fig. 1).

Minuartia macrantha is commonly found on limestone substrates although a few labels indicate volcanics. Habitats vary from *Festuca idahoensis* Elmer meadows to parklands and other open areas often associated with *Picea engelmannii* Parry ex Engelm., *Abies bifolia* A. Murray bis, *Pseudotsuga menziesii* (Mirb.) Franco, *Populus tremuloides* Michx., and *Pinus contorta* Douglas ex Loudon var. *latifolia* Engelm. With increase in elevation, it is found in krummholtz and alpine meadows, ridges, and scree and talus slopes. The elevational range is 2100–3700 m.

Flowering extends from early June into September; mature fruits are not seen until late July to September.

PHYLOGENETIC HYPOTHESES

The relationships between *Minuartia* (*Arenaria*) *macrantha* s.str., *M. filiorum*, *M. rubella*, and the *M. rossii-stricta* complex (Wolf et al. 1979; McNeill 1962) have been in dispute.

Relationship of *Minuartia macrantha* to *Minuartia rubella* (sect. *Tryphane*)

In preparation for the flora of Utah, Welsh (1993) transferred *Arenaria filiorum* to a variety of *A. rubella*. He distinguished var. *filiorum* from var. *rubella* by herbage (glabrous vs. typically glandular), sepal length (3.5–6.7 mm. vs. 2.8–4.5 mm), and seed length (0.7–1 mm. vs. 0.4–0.6 mm, respectively). Comparable character states (Welsh et al. 2003) for *A. macrantha* are: herbage glabrous, sepals 4–5 mm long, seeds 0.7–1 mm long.

Under *M. macrantha*, Welsh et al. (1993) provided the following comment: "The plant, long obscured within the mass of *A. rubella* in Utah collections, is still poorly known, and might represent nothing more than an extreme phase of that species. It stands mainly on the feature of petals substantially surpassing the sepals, which are longer than for *A. rubella* var. *rubella*, but not for *A. rubella* var. *filiorum*."

In contrast to Welsh's quotes, *Minuartia macrantha* s.l. and *M. rubella* are quite distinct; the two species are easily distinguished in the field without magnification. The former is consistently glabrous while *M. rubella* is invariably and prominently stipitate-glandular throughout the vegetative structure (see Rabeler et al. 2005). Furthermore, the two species differ in leaf morphology (1-nerved, fleshy vs. 3-nerved, not fleshy) and seed size (0.7–1 mm vs. 0.4–0.7 mm, respectively).

The relationship between *M. macrantha* s.l. and *M. rubella*, is distant at best (see below). *Minuartia macrantha* is restricted to the western United States while the latter taxon is circumboreal extending south into western North America. Maguire (1958) considered *Arenaria macrantha* s.str. and *A. filiorum* to be "the southern complement of *A. rossii*" and did not include *Minuartia* (*Arenaria*) *rubella* in this complex. In fact, *M. rubella* traditionally has been placed in the highly polymorphic *Minuartia* section *Tryphane* (Fenzl) Hayek (3–10 taxa), and is the sole member found in North America (McNeill 1962). The lectotype for the section *Tryphane* is *M. verna* (L.) Hiern (chromosomal base $x = 12$, see below), with which *Minuartia rubella* has often been confused.

Relationship of *Minuartia macrantha* with sects. *Sclerophylla* versus *Alsinanthe*

Two other relevant sections of *Minuartia* recognized by McNeill are *Sclerophylla* Mattf. (lectotype, *M. michauxii* (Fenzl) Mattf.) and *Alsinanthe* (Fenzl) Graebn. (lectotype, *M. stricta* (Sw.) Hiern). Section *Sclerophylla* is quite heterogenous and consists of seven species. Two of these taxa were not seen (=?) by McNeill: ?*Arenaria filiorum* and ?*A. macrantha*. Consequently, he did not make the combination *Minuartia filiorum* at that time. In our opinion, neither of these taxa belong in this section, one characterized in part by "leaves rigid, recurved and very thick median nerve."

Weber and Wittmann (2000) recognize *Tryphane rubella* (Wahlenb.) Rchb. on one hand and *Alsinanthe macrantha* and *A. stricta* (Sw.) Rchb. on the other. This generic realignment was predicated in part on different chromosomal base numbers: $x = 12$ for *Tryphane* (Hartman 1971; Löve and Löve 1975a and $x = 15$ for *Alsinanthe* (Löve & Löve 1975a). Although there are no known chromosome counts of *M. macrantha*, one with a base number of $x = 15$ would be consistent with Maguire's notion of *M. macrantha* being closely related to *M. rossii*. Wolf et al. (1979) reported counts based on $x = 15$ for the three members of the *M. rossii* complex, a base number also documented for *M. stricta* (Löve & Löve 1975b). Recent molecular investigations of the Caryophyllaceae have included *Minuartia* (Nepokroeff et al. 2001, Fior et al. 2006) and both suggested that *Minuartia* is polyphyletic. Nepokroeff et al. (2001 and pers. comm.) found *M. rubella* and *M. rossii* appearing in unrelated clades; unfortunately, *M. macrantha* was not sequenced.

Distribution of the *Minuartia macrantha*

Previously, comments were made as to a possible affinity of *Minuartia macrantha* s.l. to the *M. rossii* complex. Wolf et al. (1979) recognized three species in this alliance: *M. rossii*, *M. elegans* (Cham. and Schltdl.) Schischk., and *M. austromontana* Wolf and Packer. The last was a substitute name for *Arenaria rossii* var. *apetala* (Maguire *non* Fenzl; see Hartman and Nelson 1998, p. 57). The first two species are largely high Arctic in distribution whereas *M. austromontana* extends south along the spine of the Rocky Mountains from central Alberta, Canada, through Montana and west-central Wyoming, with a disjunct population in the Wallowa Mountains, Oregon, U.S.A. (*Cusick 2299*, in part, GH!; *Peck 22576*, WILLU! at OSC). One geographic outlier from the Uinta Mountains, Utah (*Harrison & Harrison 10926*, BRY!) cited by Wolf et al. (1979) represents a specimen of *M. macrantha*. In Wyoming, four historical records (pre-1960, RM, USFS; Wolf et al. 1979) of *M. austromontana* were known from the Beartooth Plateau, the Teton Range, and the northern Wind River Range. Based on recent collections (1978–2007, RM), 41 additional sites have been documented from the Absaroka, Gros Ventre, and Teton Ranges and the Big Horn Mountains. By contrast, the southern Rocky Mountain *M. macrantha* is now documented from Wyoming; an apparent disjunct from the northeastern Utah or northern Colorado. It is known from three sites (1994–2007, RM) from the Teton Range and the Gros Ventre Mountains. Other state records include Arizona and New Mexico.

Both *M. austromontana* and *M. macrantha* are sympatric in the Gros Ventre Range of northwestern Wyoming with no hint of hybridization. Their differences in gestalts and detailed morphology allow for easy separation (see Rabeler et al. 2005; *M. rossii*, *M. elegans*, *M. austromontana*, and *M. macrantha* appear near one another in the key to species of *Minuartia*, couplets 37 to 42).

Distribution of *Minuartia stricta* relative to *Minuartia macrantha* in Colorado

Minuartia stricta (Sw.) Hiern also occurs in Colorado and is disjunct in California as well from its normal range that extends from Alaska, across northern Canada, to Greenland and Eurasia (Rabeler et al. 2005, Nannfeldt 1954). It is here mentioned as it is frequently confused with *M. macrantha*. The key to species of *Minuartia* (Rabeler et al. 2005) is terminated by *M. stricta* and *M. dawsonensis* (Britton) House (couplet 43). *Minuartia macrantha* and *M. stricta* differ as follows: sepals 3.5–5 mm vs. (1.5–)2.5–3.2 mm long in flower, to 5.5 mm vs. 4 mm long in fruit (Fig. 2); seeds 0.4–0.6 mm vs. 0.7–1 mm long, respectively; and subtle leaf and habit differences. The documented distributions of *M. macrantha* and *M. stricta* in Colorado, where they are known to co-occur, are shown on Fig. 1.

Specimens of *Minuartia stricta* in the southern Rocky Mountains are listed below (based on holdings at COLO and RM):

COLORADO. Boulder Co.: above Needles Eye tunnel at Rollins Pass, 11,300 ft, 18 Jul 1969, *Brown 38* (COLO). **Garfield Co.:** E side of Heart Lake, 10,600 ft, 26 Jun 1963, *Miller 300* (COLO). **Gunnison Co.:** North Italian Mountain, 13,300 ft, 1 Aug 1949. *Langenheim 455* (COLO). **Hinsdale Co.:** Mesa Seco, above Spring Pass, 12,400 ft, 31 Jul 1964, *Weber 12167* (COLO). **Huerfano Co.:** 0.5 mi W of Iron Nipple, 12,000 ft, 17 Aug 1999, *Elliott 11048a* (RM). **Park Co.:** Sheridan Mountain, above Hilltop Mine, 13,790 ft, 12 Jul 1967, *Weber 13303* (COLO); Hoosier Ridge, east of pass, 12,500 ft, 8 Jul 1951, *Weber et al. 6551* (COLO). **Summit Co.:** Hoosier Ridge, 12,000 ft, 10 Jul 1959, *Hultén & Weber 11054a* (COLO).

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BOOK REVIEW

Ronald M. Lanner. 2007. **The Bristlecone Book: A Natural History of the World's Oldest Trees.** (ISBN 0-87842-538-1, pbk.). Mountain Press Publishing Company, P.O. Box 2399, Missoula, Montana 59806, U.S.A. (**Orders:** www.mountain-press.com, 800-234-5308). $12.00, 118 pp., color illustrations, 6" × 9".

Ronald M.Lanner is a native of Brooklyn, New York, whose teenage interest in natural history led him to become a forester. He was the editor of the *Western Journal of Applied Forestry* for its first eleven years. Now retired, he lives with his wife among the tall ponderosa pines of Placerville, California, where he is an emeritus visiting scientist at the Institute of Forest Genetics. It was at the Institute where he was employed early in his career, and where he developed his lifelong admiration for coniferous trees. His major research interests have included natural hybridization in pines, effects of aging on trees, bud development in pines, and the ecological and evolutionary effects of mutualisms of birds and pines.

His most recent book is *The Bristlecone Book: A Natural History of the World's Oldest Trees* (2007), which was preceded by *Conifers of California* (1999), *Made For Each Other: A Symbiosis of Birds and Pines* (1996), *Autumn Leaves: A Guide to the Fall Colors of the Northwoods* (1990), *Trees of the Great Basin: A Natural History* (1984), and *The Piñon Pine: A Natural and Cultural History* (1981).

Professor Lanner has written the first natural history of the bristlecone and foxtail pines of the western United States, trees that thrive in a harsh environment and live thousands of years. The essence of his book treats these trees as living organisms in their own right and brings together for the first time the captivating facts about bristlecone and foxtail pines, with a special focus on Great Basin Bristlecone Pine, the oldest tree species on earth.

I have read about these wonderful trees, especially their importance in carbon dating and "the tree ring calibration curve", but I admit that I did not think much about the living trees themselves. How old can they really be? How do they escape their enemies? How do they deal with soil erosion in the cold, windswept peaks of America's Mountain West? What characteristics are naturally selected to prolong life?

In the first chapter, Lanner describes three cousins: Great Basin Bristlecone Pines, Rocky Mountain Bristlecone Pines, and Foxtail Pines. In the next chapter, he dissects the pines and describes what they are made of. His photographs are well chosen to illustrate the text. The third chapter is devoted to the life cycle of these pines, and the fourth chapter is devoted to various shapes and forms. He describes threats to these trees in the fifth chapter, including global warming, forest fires, bark beetles, and White Pine Blister Rust. The final chapter is devoted to a discussion of what makes these trees unique: their great age, including recorded ages of living and dead trees and the secret of longevity.

There is an excellent bibliography, a very helpful glossary, and an index. This book will make a good addition to any public or college library.—*Gary L. Jennings, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

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CORRECT BASIONYM AND COMBINATION FOR *PAPPOSTIPA BARRANCAENSIS* (POACEAE)

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In the recent paper (Romaschenko et al. 2008: 184), the incorrect basionym was cited for the combination *Pappostipa barrancaensis* making the new combination invalid. The new combination is validated here with the correct basionym.

Pappostipa barrancaensis (F.A. Roig) Romaschenko, **comb. nov.** Basionym: *Stipa barrancaensis* F.A. Roig, Revista Fac. Ci. Agrar. Univ. Nac. Cuyo 11(1–2):46, t. 9, 26c. 1964 [1966]. Type: ARGENTINA: Mendoza: Dpto. Malalhue, entre Ranquil Norte y Coipo Lauquen, disminuyendo su prescencia hacia el norte, 20 Dec 1960, *A. Ruiz Leal 21547* (holotype: MEN).

REFERENCE

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J. Bot. Res. Inst. Texas 2(2): 1233. 2008

BOOK REVIEW

Angela Leiva, photographs by Gonzalo Canetti. 2007. **Trees of Cuba.** (ISBN-10: 1405029056, ISBN-13: 978-1405029056, pbk.). MacMillan Caribbean Publishers, Between Towns Road, Oxford, OX4 3PP, United Kingdom. (**Orders:** www.macmillan-caribbean.com, caribben@macmillan.com, +44 (0)1865-405843 fax). $10.70, 112 pp., color photographs, 8 1/2" × 5 1/4".

This book has been produced not for academics but for anyone wishing to identify the most commonly seen trees in Cuba, whether in the city, beside the road, on the beach or in other parts of the island. There are well over 800 species of trees growing on the island, thus this volume presents only a sample of the enormous arboreal variety to be found in Cuba.

Covering all of the most common species and some of the lesser-known varieties, nearly one hundred species are covered in this guide. Each species has a full page devoted to it with at least one full color photograph. Details included are flowers, seeds, and bark. Also included is information on medicinal and culinary uses and warnings about poisonous species.

This guide will be especially useful to the general reader. A balanced coverage of both native and cultivated species enhances its usefulness as a pocket reference. It includes a bibliography and indexes of both common and scientific names and is recommended for anyone with an interest in the flora of Cuba and the Caribbean region.

Angela Leiva is a Professor of the University of Havana and is the Director of the National Botanical Garden. She is currently working on the conservation of threatened Cuban plants. Gonzalo Canetti is known nationally and internationally for his scientific and publicity photography. He is a photo-reporter for the Cuban Ministry of Science, Technology and the Environment.—*Gary L. Jennings, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

LOS ENCINOS (*QUERCUS*: FAGACEAE) DE COAHUILA, MEXICO

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RESUMEN

Se presenta un estudio de las especies del género *Quercus* para el estado de Coahuila. La riqueza en la flora de encinos incluye 32 especies. Se incluye una clave para separar las especies, descripción de cada una de ellas, datos de distribución, datos ecológicos e ilustraciones.

ABSTRACT

A conspectus of the genus *Quercus* for the state of Coahuila is presented. The richness of oaks in the flora includes 32 species. A key to species, taxonomic descriptions, and information regarding distribution and ecology is included. Each species is additionally illustrated.

INTRODUCCION

El género *Quercus*, al cual pertenecen los encinos y robles, es el más numeroso de la familia Fagaceae, sus representantes son árboles y arbustos, siendo el componente principal de los bosques de encino y de pino-encino, de las regiones montañosas de México. Los encinos presentan una gran diversidad taxonómica, variación morfológica y distribución con un rango ecológico amplio. Para México se estiman alrededor de 150 especies, con centros de diversidad en la regiones montañosas del centro y este del país (Nixon 1993b).

Los encinos usualmente presentan un habito de crecimiento arbustivo en regiones con climas xéricos donde pueden llegar a formar matorrales densos, mientras que en condiciones mésicas, crecen especies árboreas, que integran comunidades boscosas.

Coahuila es el tercer estado más grande de la república Mexicana, se ubica en la parte media de la región septentrional del país. En su territorio se localiza la parte terminal de la Sierra Madre Oriental y su continuación en una serie de montañas aisladas con distribución en el centro y norte del estado. Aunque el clima árido es característico de Coahuila, en las zonas montañosas se presenta un clima templado y subhúmedo que permite el crecimiento de comunidades de encinos (Encina y Villarreal 2002).

La flora de encinos del estado está integrada por 32 especies, teniendo la mayor diversidad en las sierras del noroeste y las del sureste. La riqueza más alta, con 16 especies, se concentra en la Sierra del Carmen. Seis especies restringen su distribución al área del estado y regiones circunvecinas (*Quercus carmenensis*, *Q. coahuilensis*, *Q. gravesii*, *Q. hintoniorum*, *Q. invaginata* y *Q. saltillensis*). Un análisis previo sobre la flora de encinos en el estado de Coahuila llevado a cabo por Encina y Villarreal (2002) en el estado de Coahuila, muestra que las sierras de la región centro están mas relacionadas con las del noroeste que con las del sureste.

Los encinos son un grupo de plantas fáciles de colectar y ubicar como género por su hábito arbóreo o arbustivo, hojas simples y alternas y el fruto tipo bellota. Sin embargo su taxonomía no es sencilla, entre las dificultades que presenta están un número alto de especies, la variación morfológica dentro de la misma especie, su variación ecológica y la hibridación, por lo que su manejo requiere de atención especial. Las descripciones de las especies y la clave fueron elaborados con base en materiales de herbario y bibliografía. Los datos de distribución general y local, de referencias bibliográficas y colectas, y la información ecológica de datos tomados en campo. Los dibujos fueron elaborados con base en material disponible de herbario. Este trabajo presenta una revisión taxonómica de las especies de encinos conocidas para Coahuila, descripciones, datos ecológicos e ilustraciones de cada una de ellas.

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MATERIALES Y METODOS

El presente trabajo es el resultado de la revisión de información sobre el género *Quercus* para el estado de Coahuila. Se colectó material botánico durante los años 2000 al 2006 en las principales sierras del estado para enriquecer la colección de material de referencia y se consultó las colecciones de los herbarios ANSM, CFNL y TEX. El criterio taxónomico que se siguió es en parte el de Muller (en prensa) y el de Nixon (1993a y b).

Las descripciones de las especies y la clave fueron elaborádos en base a materiales de herbario y bibliografía. Los datos de distribución general y local de referencias bibliográficas y colectas, y la información ecológica de datos tomados en campo. Los dibujos son obra de Miguel Agustín Carranza Pérez, para su elaboración generalmente se emplearon varios ejemplares del material disponible del herbario ANSM.

Se presenta una descripción de las especies, donde se menciona en primer término el nombre científico, los sinónimos se escriben entre paréntesis seguido de la descripción de cada especie. Se incluye además su distribución a nivel general y para el estado; así como información sobre los tipos de vegetación donde se presentan, las especies asociadas, rangos altitudinales, e información general sobre su abundancia.

Generalidades del área de estudio

El estado de Coahuila se ubica en el norte de la republica Mexicana, entre los 24°32'13 y los 29°52'47" de latitud norte, y entre los 99°50'30" y los 103°57'03" de longitud oeste (mapa).

Clima.—Por su ubicación el estado se caracteriza por presentar climas continentales secos, que van desde los semicálidos, hasta templados en las partes altas. La precipitación es escasa, de 300 a 500 mm, para todo el estado. La temperatura es extremosa, la humedad atmosférica baja y la evapotranspiración es elevada. El clima es extremoso, con veranos muy calurosos e inviernos fríos. La parte nororiental tiene los climas más húmedos y cálidos, el occidente es muy seco, mientras que el centro y sur tienen climas desde secos y templados hasta templados subhúmedos en las cumbres de las sierras.

Geología y Suelos.—Los sedimentos marinos continentales del paleozoico al cuaternario forman en su mayoría el territorio coahuilense. Las rocas calizas del mesozoico son las más típicas, los plegamientos tienen dirección Este-Oeste en el sur y Noreste-Sureste en el centro y norte del estado. Existen afloramientos de rocas ígneas del triásico al cuaternario. Rocas metamórficas paleozoicas afloran en áreas pequeñas y dispersas.

Los suelos que se presentan con mayor frecuencia son Xerosoles y Yermosoles, que son suelos localizados en zonas con climas áridos. Los Litosoles y Regosoles se presentan en áreas montañosas, son de origen calcáreo y se mezclan con Rendzinas, con mayor contenido de materia orgánica (Anónimo 1983).

Fisiografía.—En el estado se reconocen las siguientes provincias fisiográficas (Villarreal et al. 1996):

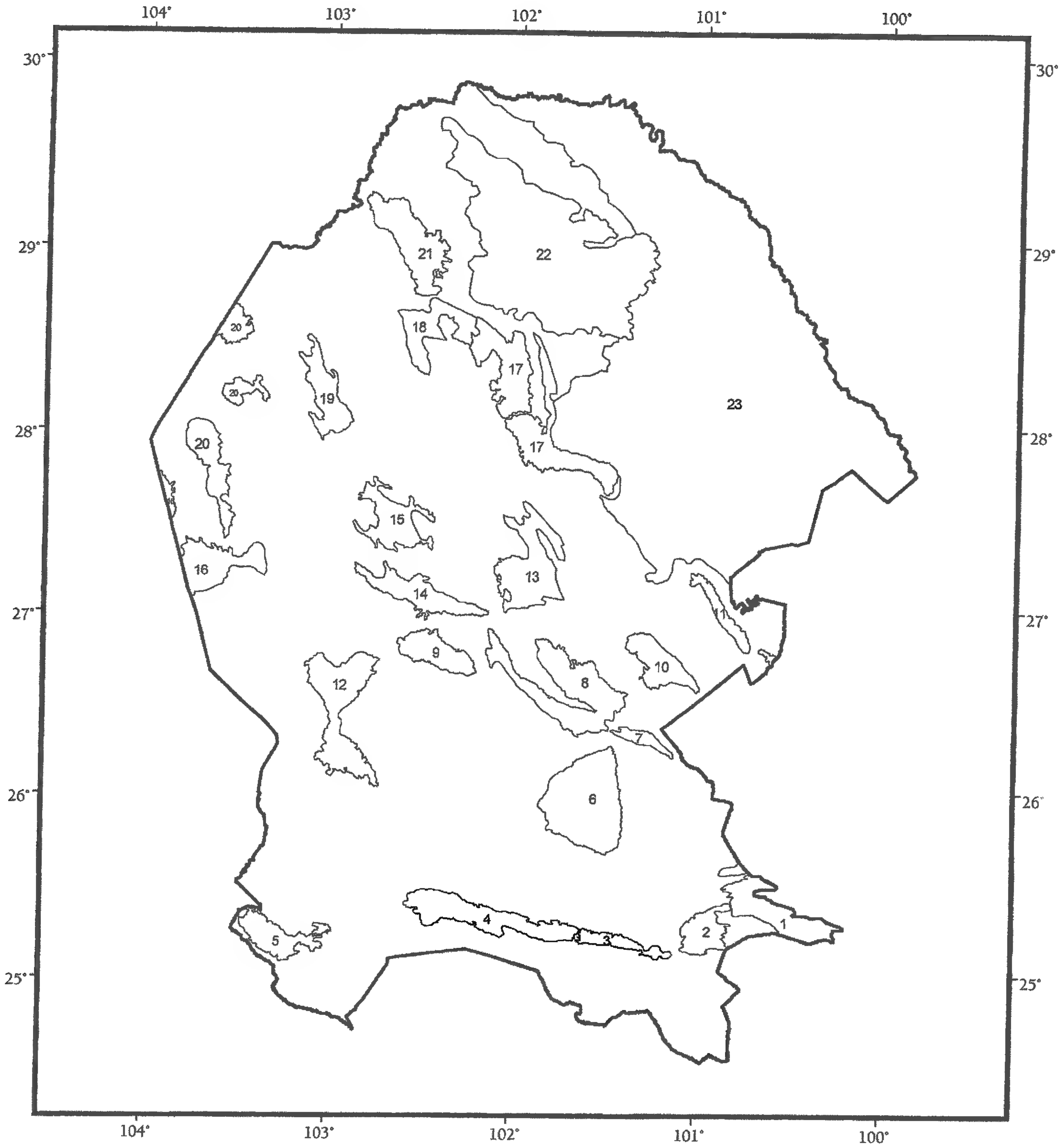
1) Provincia de la Planicie Costera del Golfo que ocupa el noreste del estado. Esta formada por una serie de llanuras y lomeríos bajos con declives suaves con altitudes que van de los 550 m a los 2200 m. La vegetación que caracteriza a esta región es el Matorral Tamaulipeco.

2) Provincia de la Sierra Madre Oriental, formada por la terminación en el sureste del estado de la cordillera de la Sierra Madre, proveniente del centro del país, continuándose hasta el noroeste del estado a través de una serie de sierras aisladas. Las partes más altas alcanzan los 3400 m y la vegetación presente es el Matorral Submontano en las partes bajas y exposiciones xéricas, y bosque en las partes mésicas.

3) Provincia del Desierto Chihuahuense, formada por valles, bolsones y lagunas ubicadas en el oeste y centro de estado, en la región del Altiplano Mexicano. Es la región más árida y las altitudes van desde los 800 a los 1900 m. La vegetación característica son los diferentes tipos de Matorral Desértico.

Vegetación.—De los seis tipo de vegetación citádos para Coahuila por Villarreal y Valdés (1993), los encinos están presentes principalmente en el Matorral Submontano y el Bosque de Montaña, y ocasionalmente en el Matorral Tamaulipeco y la Vegetación Riparia.

Matorral Submontano.—Este tipo de vegetación ocupa cerca del cinco por ciento de la superficie del estado. Esta formado por arbustos y árboles pequeños que crecen en laderas y cañones con condiciones de alta humedad. Este tipo de comunidad puede presentarse en forma tanto dispersa como muy densa, mezclándose con elementos del Matorral Desértico en las partes bajas de las sierras y extendiéndose hasta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Mapa. Localidades del estado de Coahuila donde se distibuye el género *Quercus*.

1. Sierra de Arteaga
2. Sierra de Zapalinamé
3. Sierra de La Concordia
4. Sierra de Parras
5. Sierra de Jimulco
6. Sierra de La Paila
7. Sierra de La Gavia
8. Sierra de San Marcos
9. Sierra de La Fragua
10. Sierra de La Gloria
11. Sierra Pájaros Azules
12. Sierra Delicias
13. Sierra de La Menchaca
14. Sierra de La Madera
15. Sierra del Fuste
16. Sierra Mojada
17. Sierra de Santa Rosa
18. Sierra Encantada
19. Sierra del Pino
20. Sierra Cruces
21. Sierra del Cármen
22. Serranía del Burro
23. Planicie Costera del Golfo

el Bosque de Montaña en las porciones más altas. Es frecuente encontrar *Quercus intricata*, *Q. invaginata*, *Q. pringlei*, *Q. pungens*, *Cercocarpus montanus*, *C. fothergilloides*, *Vauquelinia corymbosa*, *Ptelea trifoliata*, *Rhus virens*, *R. microphylla*, *Berberis trifoliata*, *Calia secundiflora*, *Fraxinus greggii*, *Acacia berlandieri*, *Ungnadia speciosa*, *Colubrina greggii*, *Mimosa biuncifera*, *Brahea berlandieri*, *Dasylirion cedrosanum* y *Eysenhardtia texana*.

Bosque de Montaña.—Este tipo de vegetación presenta las siguientes comunidades:

1) Bosque de Encino. En valles intermontanos y cañones de las sierras, donde el clima es templado y subhúmedo. Usualmente sigue al Matorral Submontano en altitudes de 1200 a los 1800 m, y ocupa menos del 1% del estado. Esta dominado por árboles en poblaciones esparcidas o densas, muy homogéneas, donde es frecuente *Quercus gravesii*, *Q. grisea*, *Q. laceyi*, *Pinus cembroides*, *P. arizonica*, *Garrya ovata*, *Juniperus flaccida*, *Arbutus xalapensis*, *Fraxinus cuspidata* y *Prunus serotina*.

2) Bosque de Pino. Este tipo de comunidad dominada por especies del género *Pinus*, ocupa cerca del 2% de la superficie. Es frecuente en laderas y partes altas de sierras con climas templados y subhúmedos. El mas común es el Bosque de Pino Piñonero, donde las especies de *Pinus cembroides*, *P. remota* y *P. pinceana* son dominantes. Otras especies asociadas son *Juniperus saltillensis*, *J. erythrocarpa*, *Quercus intricata*, *Q. striatula*, *Q. pringlei*, *Rhus virens*, *Yucca carnerosana*, *Tillandsia recurvata* y *Bouteloua gracilis*. Otras comunidades están dominadas por *Pinus arizonica* en las sierras del centro y norte del estado, mientas que en la Sierra Madre Oriental se presenta *Pinus pseudostrobus*, *P. greggii*, *P. hartwegii*, *P strobiformis* y *P. teocote*.

3) Bosque de Oyamel. Localizado en las partes altas de las sierras, en altitudes que van de los 2300 a los 3000 m. Ocupa el 2% del área y está dominado por *Pseudotsuga menziesii* y *Abies vejarii*. Otras especies frecuentes son *Quercus saltillensis*, *Q. greggii*, *Arctostaphylos pungens*, *Pinus strobiformis*, *Cupressus arizónica* y *Salix lasiolepis*.

4) Vegetación Subalpina. Se presenta en las cimas de la Sierra de Arteaga, cubriendo menos del 1% del estado. La comunidad está dominada por arbustos y herbáceas donde *Pinus culminicola*, *P. hartwegii*, *Quercus hintoniorum* y *Agave montana* son frecuentes.

Matorral Tamaulipeco.—Se distribuye en planicies y lomeríos del noreste del estado, ocupa cerca del 20 % del área, en lugares de los 240 a los 850 m. Esta dominado por *Acacia rigidula*, *Leucophyllum frutescens* y *Prosopis glandulosa*. En lugares húmedos como cañadas u orilla de arroyos o donde el manto acuífero es superficial, se presenta *Quercus fusiformis* en forma aislada o en comunidades densas llamadas localmente "motas."

Vegetación Riparia.—Restringida a los pocos ríos y arroyos que existen en el estado tributarios del Río Bravo. Estas comunidades crecen en los márgenes de corrientes de agua, donde la humedad permite su desarrollo. Las especies mas frecuentes son *Taxodium mucronatum*, *Platanus glabrata*, *Salix nigra*, *Carya illinoensis*, *Acacia farnesiana* y ocasionalmente *Quercus fusiformis*.

TRATAMIENTO TAXONOMICO (FAGACEAE)

Árboles, algunas veces arbustos. Hojas simples, alternas, con venación pinnada, de enteras a lobuladas, generalmente con estípulas caedizas. Flores unisexuales dispuestas normalmente en amentos o espigas; perianto de 4–7 lóbulos; flores masculinas con el mismo o doble número de estambres que las piezas del perianto, aunque a veces pueden llegar a 40; flores femeninas con un perianto de 4–8 lóbulos, pistilo tricarpelar, cada una protegida por un involucro basal. Fruto una nuez o aquenio agrandado, en grupos de 1–3, protegidos en la base o envueltos completamente por una cúpula de escamas o espinas.

Comprende 9 géneros y unas 800 especies, en su mayor parte originarias de zonas templadas y subtropicales del Hemisferio Boreal (Nixon 1997). Proporcionan algunas de las maderas más importantes del mundo, con múltiples aplicaciones, además de producir corcho, taninos, frutos comestibles y plantas de interés ornamental.

Quercus L., Sp. Pl. ed. 2, 2:994. 1753. Especie Tipo: *Quercus robur* L.

Arboles o arbustos monoicos; ramillas usualmente acanaladas; yemas cubiertas por escamas ciliadas; estípulas deciduas o raramente persistentes; hojas alternas, persistentes o deciduas, pecioladas, limbos con bordes enteros, aserrados, dentados o lobulados. Flores masculinas en amentos colgantes, cada flor con un perianto de 4–7 lóbulos y 6 a 12 estambres, con anteras cortas y filamentos delgados; las femeninas solitarias o en grupos pequeños, cada una en el interior de un involucro constituido por numerosas escamas, pistilo de tres cárpelos que forman un ovario trilocular, cada lóculo con dos óvulos y tres estilos libres. Fruto una bellota, conteniendo una nuez (aquenio agrandado), una semilla viable, los otros cinco óvulos restantes son abortados y se adhieren a la semilla desarrollada, rodeada en la base por una cúpula formada por escamas imbricadas, maduración anual o bienal.

El género está formado por unas 400 especies (Nixon 1997), en su mayoría originarias de las zonas templadas del hemisferio norte, con algunas presentes en el sureste de Asia y solo una especie en el norte de Sudamerica (*Q. humboldtii* en Colombia). En México son abundantes principalmente en las áreas montañosas, la mayor diversidad se presenta en el centro y sur del territorio, siendo el país con el mayor número de especies. En Coahuila se estima que existen unas 32 especies restringidas a las áreas montañosas y unas cuantas en las planicies bajas del noreste del estado.

Se les conoce con el nombre de encino, roble, ahuatl, y en ingles como oak. Al parecer en Coahuila se usa en general el nombre de "encino" para reconocer a las especies de *Quercus*, a excepción de los encinos arbustivos que se les conoce como "encinos chaparros" o "charrasquillos." Los principales caracteres para el reconocimiento de las especies están basados en las hojas. La forma, tamaño, borde, color, indumento y venación, entre otras, son los más usados en su diferenciación. Algunas especies, suelen ser polimorfas, en otras ocaciones se presentan hibridaciones que aumentan la complejidad morfológica. Las hojas pueden variar dentro de la misma especie según sean ejemplares jóvenes o adultos, o incluso dentro de la misma planta dependiendo de las partes donde se presenten. Otros carcteres importantes en la taxonomía son el tipo de indumento en la hoja, que puede variar en densidad y tipo de pelos que lo forma. También la morfología de la bellota es importante, como el tamaño de la cúpula y nuez, además de la forma de las escamas.

I. Quercus sect. Quercus.

Árboles o arbustos. Corteza usualmente rugosa, escamosa, gris o blancosa. Hojas con margen entero, dentado o lobado, dientes mucronados. Flores estaminadas con cáliz de 2–6 lóbulos, anteras apiculadas. Flores pistiladas con cáliz adnado al ovario y estilo alargado. Fruto anual, cupula con escamas con base engrosada y nuez glabra a tomentulosa.

Quercus arizonica
Quercus carmenensis
Quercus fusiformis
Quercus gambelii
Quercus grisea
Quercus greggii
Quercus intricata
Quercus invaginata
Quercus laceyi
Quercus laeta
Quercus mohriana
Quercus muehlenbergii
Quercus oblongifolia
Quercus polymorpha
Quercus potosina
Quercus pringlei
Quercus pungens var. *pungens*
Quercus pungens var. *vaseyana*
Quercus rugosa
Quercus sinuata
Quercus sinuata var. *breviloba*
Quercus tuberculata

II. Quercus sect. Lobatae, Hort. Brit. 385. 1830.

Árboles o arbustos. Corteza lisa a fisurada, café a negruzca. Hojas con margen entero, dentado o lobado, dientes y lóbulos usualmente terminados en aristas. Flores estaminadas con cáliz de 2–6 lóbulos, anteras usualmente retusas. Flores pistiladas con cáliz libre del ovario y estilo linear a espatulado. Fruto bianual, raramente anual, cupula con escamas con base plana, algunas veces engrosada y nuez tomentosa.

Quercus coahuilensis
Quercus canbyi
Quercus emoryi
Quercus fulva
Quercus gravesii
Quercus hintoniorum
Quercus hypoleucoides
Quercus hypoxantha
Quercus mexicana
Quercus saltillensis
Quercus sideroxyla

CLAVE DE LAS ESPECIES DE *QUERCUS* DEL ESTADO DE COAHUILA

1. Limbos con las nervaduras fuertemente impresas en la superficie del haz; margen cartilaginoso, engrosado, moderado o fuertemente revoluto.

2. Margen de la hoja con dientes aristados, especialmente en la mitad distal de la hoja, si es entero entonces con el ápice aristado; haz verde claro, glauco o amarillento, opaco.

3. Envés con indumento aterciopelado denso, persistente, no fácilmente desprendible.

4. Hojas ampliamente elípticas a obovadas; envés con tomento amarillo-cafezusco de pelos multirradiados y de pelos simples **Quercus fulva**

4. Hojas estrechamente elípticas, oblongas o lanceoladas; envés con tomento denso amarillo-cremoso a blanquecino de pelos fasciculados, sin pelos simples.

5. Margen con dientes evidentes en la mitad distal; limbos con ápice redondeado a obtuso; base cordada a redondeada; pecíolos 3–10 mm de largo **Quercus sideroxyla**

5. Margen entero o con pocos dientes en la mitad distal; limbos con el ápice frecuentemente agudo; base redondeada a cuneada; pecíolos 5–15 mm largo **Quercus hypoleucoides**

3. Envés con indumento lanoso-tomentoso, denso, fácilmente desprendible, o sin lo anterior entonces la epidermis con pelos glandulares.

6. Indumento del envés formado por mechones de pelos fasciculados restringidos a las axilas de la nervadura media y abundantes pelos glandulares uniseriados **Quercus hintoniorum**

6. Indumento del envés formado de pelos fasciculados que cubren totalmente la superficie, pelos glandulares ausentes.

7. Limbos comúnmente con 1–3(–4) dientes por cada lado, en el último tercio de la hoja; indumento amarillo-blanquecino de pelos con radios enredados **Quercus coahuilensis**

7. Limbos con 4–6 dientes en cada lado, distribuidos a lo largo del limbo; indumento café amarillento de pelos fasciculados no enredados **Quercus hypoxantha**

2. Margen entero o con dientes cortos terminando en mucrón, en especial hacia la mitad distal de la hoja; haz comúnmente verde oscuro y lustroso.

8. Limbos menos de 5 cm de largo, si son más grandes entonces el envés es notablemente tomentoso; margen fuertemente revoluto, venación no fuertemente reticulada.

9. Margen con 3–5 dientes en cada lado, raras veces entero; indumento lanoso y rizado, café amarillento; limbos obovados a elípticos **Quercus greggii**

9. Margen comúnmente entero, raras veces con 3–5 dientes en cada lado; indumento corto, denso, amarillo-cremoso; limbos usualmente oblongos **Quercus intricata**

8. Limbos de 4–15(–20) cm de largo, si son más cortos entonces el envés no es notablemente tomentoso; margen poco revoluto; venación fuertemente reticulada.

10. Limbos ampliamente obovados a elípticos, fuertemente cóncavos hacia el envés; epidermis del envés con pelos glandulares rojizos **Quercus rugosa**

10. Limbos elípticos, oblongos hasta oblanceolados, planos; epidermis sin pelos glandulares.

11. Hojas de 4 a 8 cm largo con el ápice agudo a obtuso; pecíolos hasta 1 cm de largo **Quercus arizonica**

11. Hojas de hasta 15 cm de largo con el ápice angostamente obtuso; pecíolos de 1.5 a 3 cm de largo **Quercus polymorpha**

1. Limbos con las nervaduras no fuertemente impresas en la superficie del haz; margen ligeramente revoluto a plano.

12. Margen lobulado, con la escotadura muy profunda, cada lóbulo terminando en una arista flexible de 2–3 mm de largo.

13. Limbos de las hojas ovados u obovados de 6–8 cm de ancho, típicamente con tres dientes en la parte apical de La hoja y con dos a tres lóbulos a cada lado **Quercus gravesii**

13. Limbos de las hojas lanceolado-elípticos de 2–4 cm de ancho, ápice acuminado y tres a cinco lóbulos en cada lado **Quercus canbyi**

12. Margen entero o lobulado, si presenta lóbulos entonces con la escotadura no profunda y terminando en un mucrón o arista de hasta 2 mm de largo.

14. Ápice agudo, algunas veces obtuso, terminando en una arista fácilmente quebradiza; envés con indumento diminuto o puberulencia escasa fácilmente desprendible, glabrescente; margen entero o con dientes aristados.

15. Margen siempre entero; hojas estrechamente ovadas a oblongas; envés con indumento de aspecto punteado, esparcido en toda la superficie formado por pelos fasciculados, estipitados, con radios retorcidos y algo enredados **Quercus mexicana**

15. Margen con dientes aristados, algunas veces entero, plano a cartilaginosamente engrosado;

hojas comúnmente lanceoladas u oblongas; envés con penachos de pelos amarillentos en las axilas de la nervadura media.

16. Limbos gruesos y coriáceos, lanceolados; haz verde claro; envés con pelos amarillos fasciculados hasta completamente glabro ________ **Quercus emoryi**

16. Limbos delgados y flexibles, lanceolados a oblongo-lanceolados; haz verde oscuro; envés glabro ________ **Quercus saltillensis**

14. Ápice obtuso a redondeado, si es agudo terminando en un mucrón; envés con indumento no fácilmente desprendible; margen algunas veces entero, frecuentemente con dientes notorios, apiculados o con mucrones poco evidentes.

17. Envés con indumento de pelos estrellados, finos y apresados, dando una tonalidad canescente o cremosa hasta blanquecina.

18. Margen fuertemente dentado, con los dientes prominentes a ligeramente lobulado, raras veces entero; ramillas café rojizas.

19. Haz opaco a ligeramente lustroso, con indumento estrellado denso, bases de los pelos endurecidos muy ásperas al tacto; limbo con el margen crispado ________ **Quercus pungens** var. **pungens**

19. Haz muy lustroso, con indumento esparcido, ligeramente áspero al tacto; limbo con el margen casi plano ________ **Quercus pungens** var. **vaseyana**

18. Margen entero o con dientes poco prominentes, irregulares, si presenta márgenes onduladamente crispados entonces, los lóbulos y el ápice del limbo son usualmente redondeados; ramillas café grisáceo.

20. Limbos delgados y flexibles, obovados u oblanceolados; haz verde oscuro y lustroso ________ **Quercus sinuata** var. **breviloba**

20. Limbos gruesos y rígidos, oblongos a elípticos; haz verde claro, poco lustroso ________ **Quercus fusiformis**

17. Envés con indumento de pelos fasciculados, a veces esparcidos dando el aspecto de glabro, o muy denso formando un tomento evidente.

21. Envés glabro o glabrescente; margen dentado hasta lobulado, raras veces entero.

22. Hojas de 2–6(–8) cm largo; limbos lanceolados a elípticos hasta oblongos; envés con tomento flocoso o con parches de pelos, pronto glabrescente.

23. Limbos verde grisáceo opaco en ambas superficies, glabro o con indumento persistente cerca de la base de las nervaduras; ápice y dientes no mucronados; nervaduras del envés muy prominentes y las del haz con las venillas muy reticuladas y esclerotizadas formando un retículo blanquecino evidente ________ **Quercus oblongifolia**

23. Limbos con haz verde o verde-azul; envés glauco, glabro o con indumento glandular; con ápice y dientes mucronados; nervaduras del envés poco prominentes, algunas veces con las nervaduras del haz con las venillas blancas y reticuladas no esclerotizadas, sin formar un retículo blanquecino evidente ________ **Quercus pringlei**

22. Hojas mas de 8 cm de largo; limbos oblongos o elípticos, si menores, entonces con el limbo ovado u obovado; envés glabrescente, glabro o con indumento inconspicuo o solo en las nervaduras principales.

24. Margen con lóbulos redondeados oblongos y llegando cerca de la nervadura media a sinuado; ápice redondeado.

25. Hojas glaucas o verde amarillentas, glabras al madurar; ramillas maduras y pecíolos glabrecentes, café rojizos; envés comúnmente glabro ________ **Quercus laceyi**

25. Hojas verde oscuro, con pelos esparcidos, persistentes; ramillas maduras y pecíolos con indumento, café grisáceo; envés con pelos escasos persistentes ________ **Quercus gambelii**

24. Margen dentado o cortamente lobulado, si es entero o crenado entonces con el ápice obtuso o redondeado.

26. Hojas con nervios laterales ramificados y anastomosados hacia el ápice; margen dentado o entero, no repando; peciolos rojizos cerca de la base; escamas de la cúpula engrosadas en la base ________ **Quercus tuberculata**

26. Hojas con nervios laterales paralelos y terminando en el margen de los dientes; margen repando, dentado o con lóbulos cortos; pecíolos no rojizos cerca de la base; escamas de la cúpula casiplanas ________ **Quercus muehlenbergii**

21. Envés con indumento, no glabro; margen entero o con pocos dientes toscos, nunca lobulado.
    27. Envés con indumento grisáceo o blanquecino hasta amarillento, densamente lanoso-tomentoso, cubriendo totalmente las nervaduras principales, algunas veces es esparcido o tomentuloso.
        28. Limbos elípticos a lanceolados; margen entero o dentado; ápice agudo u obtuso y terminando en un mucrón.
            29. Hojas 3–6(–8) cm de largo, indumento del envés denso gris-blanquecino, de pelos multirradiados ____ **Quercus grisea**
            29. Hojas 1–2.5(–4) cm de largo, indumento del envés café-amarillento, de pelos fasciculados estipitados ____ **Quercus striatula**
        28. Limbos oblongos u obovados; margen con pocos dientes, si entero entonces con las nervaduras anastomosadas; ápice redondeado, raras veces agudo.
            30. Margen de la cúpula involuto; haz verde claro, opaco; limbos obovados algunas veces oblongos, con dientes toscos crispados en la mitad distal de la hoja ____ **Quercus invaginata**
            30. Margen de la cúpula no involuto; haz verde oscuro, lustroso; limbos oblongos a elípticos, enteros o con dientes cortos ____ **Quercus mohriana**
    27. Envés comúnmente con indumento esparcido, cubriendo la epidermis o solo a través de las nervaduras, raras veces denso.
        31. Hojas de 5–15 cm largo; limbos elípticos, oblongos u obovados ____ **Quercus laeta**
        31. Hojas comúnmente menos de 5 cm de largo, rara vez más grandes; limbos obovados o suborbiculares, algunas veces elípticos u oblongos.
            32. Margen de la cúpula involuto; limbos gruesos y coriáceos, con puntos resinosos en el envés; margen de la hoja con dientes terminados en mucrones ____ **Quercus potosina**
            32. Margen de la cúpula no involuto; limbos delgados y flexibles, sin puntos resinosos en el envés; margen de la hoja comúnmente con dientes o lóbulos irregulares ____ **Quercus carmenensis**

DESCRIPCIÓN DE LOS ENCINOS DE COAHUILA

Quercus arizonica Sarg., Gard. & Forest. 8:92. 1895. (**Fig. 1**). Tipo: E.U.A. Arizona: Fort Huachuca, *C.S. Sargent s.n.* (holotipo: GH).

Quercus sacame Trel., Mem. Natl. Acad. Sci. 20:89, pl. 142. 1924.
Quercus endemica C.H. Mull., Amer. Midl. Naturalist 18:846. 1937.

Árbol o arbolito de 8–12 m de alto; corteza gruesa, fisurada, gris claro; ramillas de 1.5–2.5 mm de grueso, con pelos fasciculados; yemas ovoides, subagudas o redondas de 3 mm largo, café amarillento opaco; estípulas persistentes filiformes o subuladas, de 5–8 mm de largo, pubescentes. Hojas persistentes o subpersistentes, gruesas y coriáceas; pecíolos de hasta 1 cm de largo, con indumento de pelos fasciculados esparcidos; limbos elípticos u oblongos hasta oblanceolados, de 4–8 cm de largo y 1–3 cm de ancho, ápice agudo a obtuso, base cordada o redondeada, margen cartilaginoso revoluto, entero o con dientes toscos cerca del ápice, terminando en un mucrón, haz algo lustroso, con indumento diminuto y esparcido, de pelos fasciculados, envés opaco, con pelos fasciculados estipitados, abundantes, con frecuencia glauco; nervaduras 9–11 en cada lado, ramificadas y anastomosadas hacia el margen, impresas en el haz, muy prominentes y reticuladas en el envés. Inflorescencias masculinas de hasta 3 cm de largo, raquis tomentoso, con flores abundantes. Inflorescencias femeninas de hasta 2 cm de largo, con tomento corto, de 2–6 flores. Fruto anual, solitario o en pares, subsésil o con pedúnculos cortos; cúpula hemisférica, de 8–14 mm de ancho y 5–7 mm de alto, márgenes gruesos, escamas ovadas, base con tuberculo central, tomentosa, ápice redondea do, delgado, apresado, puberulento y café, nuez ovoide de 8–12 mm de largo, café claro, glabras, incluida cerca de la mitad en la cúpula.

Distribución.—Se distribuye desde el suroeste de Arizona, Nuevo México, suroeste de Texas (Trans-Pecos) a través de la Sierra Madre Occidental en el este de Sonora, Chihuahua, Durango y Baja California. En Coahuila se encuentran poblaciones relicto en las sierras del Carmen y Las Cruces al noroeste del estado. Es una especie característica del bosque de pino-encino y bosque de encino, asociándose principalmente con especies de *Quercus gravesii*, *Q. mohriana*, *Q. hypoleucoides*, *Q. laceyi*, *Q. sinuata* var. *breviloba*, *Q. rugosa*, *Q. muehlenbergii*, *Juniperus flaccida*, *Rhus aromatica*, *Garrya ovata*, *Arbutus xalapensis*, *Salvia regla*, *Pinus remota*, *P. arizonica* var. *stormiae*, *Acer grandidentatum*, *Tilia mexicana*, *Prunus serotina* y *Cupressus arizonica* entre otras. Crece en altitudes entre 2100–2600 m, principalmente sobre laderas medias a altas, con exposición norte y noroeste, así como entre cañones, con suelos derivados de rocas ígneas o sedimentarias. Especie considerada como rara para el área del estado.

Notas.—Se reconoce por sus hojas gruesas elípticas a oblongas, de más de 4 cm de largo, margen entero o con pocos dientes mucronados, envés verde amarillento con venación prominente e indumento denso. Escamas de la cúpula con base tuberculada. Puede confundirse con *Q. hypoleucoides* por las caracteristicas de la hoja.

Material examinado: **Mpio. Acuña:** sierra del Carmen, western scarp, oak woodland forest, 2,500 m, 13 jul 1997, *S. Wood, G. Harper* y *D. Doan-Crider s.n.* (ANSM); El Mirador, 28°96'N y 102°57'W, 2,266 m, 17 jul 1997, *S. Wood, G. Harper* y *D. Doan-Crider s.n.* (ANSM).

Quercus canbyi Trel., Mem. Natl. Acad. Sci. 20:188, pl. 379. 1924. (**Fig. 2**). Tipo: MÉXICO. Nuevo León: Monterrey, *C.G. Pringle 2393* (holotipo: B; isotipos: GH, MO).

Quercus karwinskii Trel., Mem. Natl. Acad. Sci. Whas. 20:188. 1924.
Quercus graciliramis C.H. Mull., J. Arnold Arbor. 17:177. 1936.

Árbol de 8–15 m de alto; ramillas rojizas, glabras, con pocas lenticelas, de 2–3 mm de grueso; yemas café, ovoides, acuminadas de 2–3 mm de largo; estípulas ciliadas, caedizas. Hojas deciduas, delgadas; pecíolos glabros de 15–20 mm de largo; limbos lanceolados, atenuados hacia el ápice, de 5–10 cm de largo y 2–3(–4) cm de ancho; base generalmente cuneada, en algunas ocasiones redondeada; margen con tres a cinco pares de lóbulos cortos, anchos en la base, aristados, haz glabro o con escasos pelos estrellados diminutos y envés con mechones de pelos fasciculados estipitados en las axilas de las venas y ocasionalmente a lo largo de la nervadura central y la base del pecíolo; nervaduras 6–10 en cada lado. Inflorescencias masculinas de 2–3 cm de largo, pubescentes. Inflorescencias femeninas de 5–10 mm largo. Fruto sésil, en grupos de uno a tres, sobre un pedúnculo de cerca de 4 mm; cúpula de 6–10 mm de diámetro y de 4–7 mm de alto; escamas ovadas delgadas, con el ápice truncado, café rojizo y puberulentas; nuez ovoide, de 12–15 mm de largo, incluida de un medio a un tercio en la cúpula.

Distribución.—Su área de distribución comprende los estados de Nuevo León y Tamaulipas. En Coahuila se presenta en la Sierra de Pájaros Azules, en el centro del estado, en los límites con Nuevo León. Crece en bosque de encino asociada con *Quercus invaginata*, *Q. laceyi*, *Q. gravesii*, *Q. polymorpha*, *Juglans microcarpa*, *Fraxinus greggii*, *Chiococca alba*, *Colubrina greggii*, *Rhus virens*, *Pistacia texana* y *Ungnadia speciosa*, en altitudes entre 700–850 m, sobre laderas bajas y en el fondo de cañones húmedos, con exposición noreste. Especie rara para el área del estado.

Notas.—Se reconoce por las hojas delgadas, casi glabras, verde oscuro, lanceoladas de menos de 10 cm de largo, margen con 3–5 pares de lóbulos cortos y aristados, envés con pelos fasciculados en la nervaduras principales. Escamas de la cúpula casi planas. Presenta semejanzas morfológicas con *Quercus gravesii*.

Material examinado: **Mpio. Candela:** sierra Pajaros Azules, rancho Santa María, límites con Lampazos N. L., 780 m, 14 jul 2002, *J.J. Medellín V. 243,341* (CFNL).

Quercus carmenensis C.H. Mull., Amer. Midl. Naturalist 18:847. 1937. (**Fig. 3**). Tipo: MÉXICO. Coahuila: Mpio. Acuña, sierra del Carmen, canyon Sentinela, *F.L. Wynd y C.H. Muller 639* (holotipo: ILL; isotipos: GH, MO).

Quercus undulata Torr., Ann. Lyceum. Nat. Hist. N.Y. 2:248. 1828.

Arbusto rizomatoso de 0.5–2.0 m de alto, o árboles de hasta 12 m de alto; corteza gris clara, a cuadros o surcada; ramillas de 1–1.5 mm de grosor, de color rojo, con lenticelas pálidas y prominentes y con pelos multirradiados yemas casi redondas de 1–1.5 mm de largo, café claro; estípulas persistentes de 3–6 mm de largo, en forma de arista. Hojas deciduas, delgadas y flexibles, con pecíolos de (2–)5–10 mm de largo y casi 1 mm de grosor, glabrescentes, rojos; limbos oblongos a obovados, de (2–)3–5 cm de largo y 1–3 cm de ancho, ápice obtuso a redondeado, base cuneada a redondeada, margen entero, ondulado, lobulado o

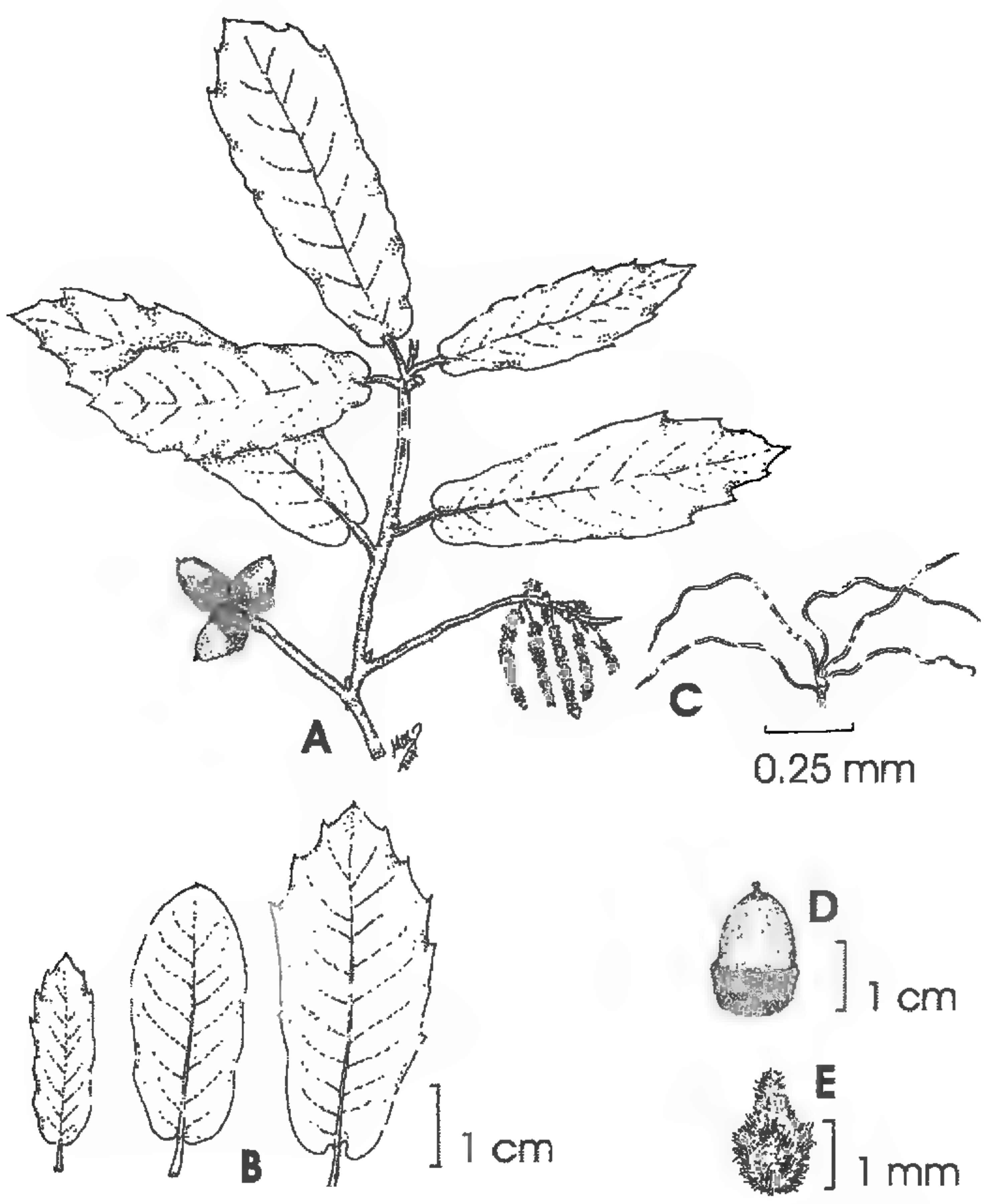
A
C
0.25 mm
D
1 cm
E
B
1 cm
1 mm

Fig. 1. *Quercus arizonica*. **A,** rama con amentos y bellotas; **B,** variación en hoja; **C,** pelo fasciculado estipitado; **D,** bellota; **E,** escama de la cúpula.

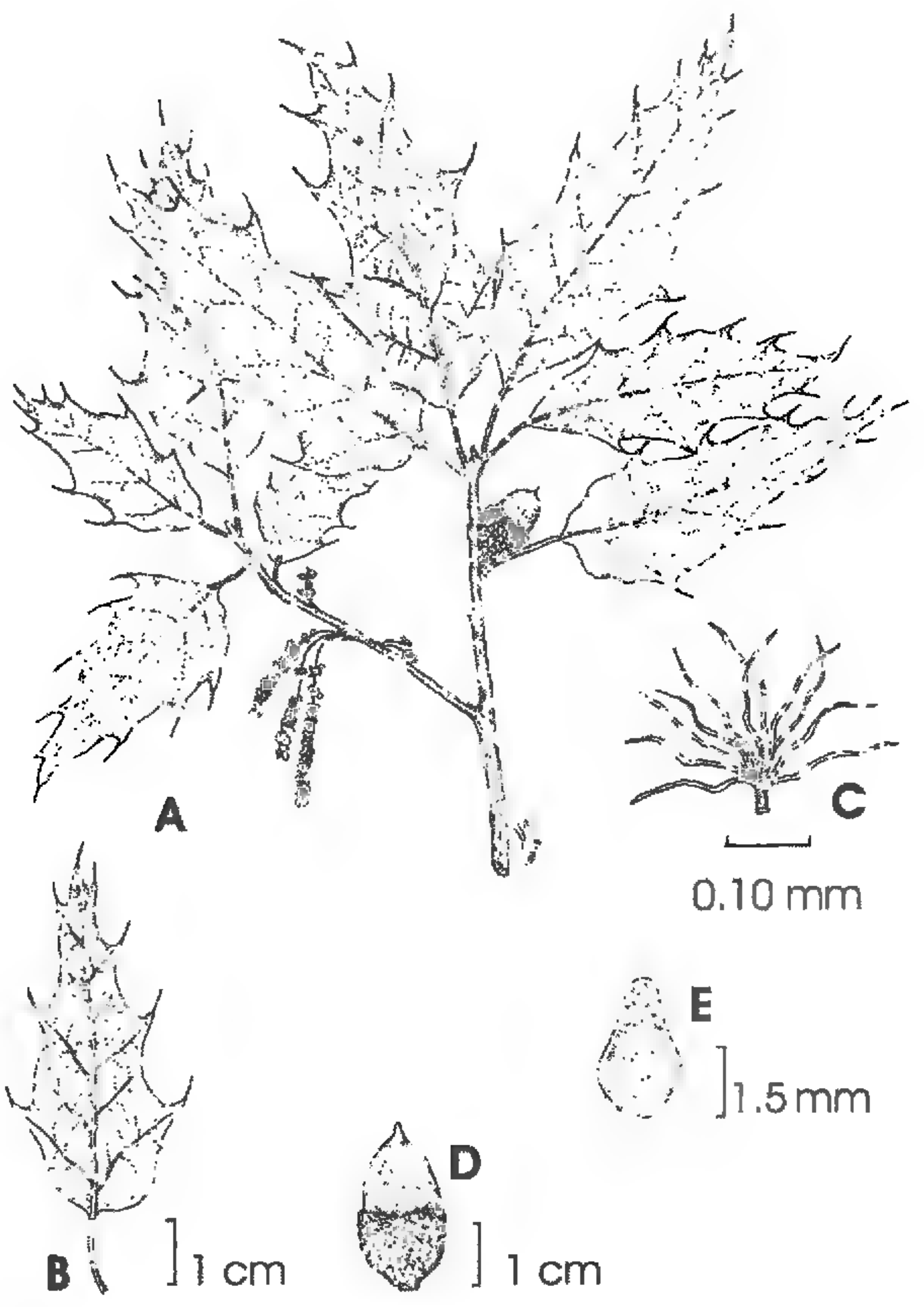
A
C
0.10 mm
E
1.5 mm
D
B
1 cm
1 cm

Fig. 2. *Quercus canbyi*. **A,** rama con hojas, amentos y bellota; **B,** hoja; **C,** pelo fasciculado estipitado; **D,** bellota; **E,** escama de la cúpula.

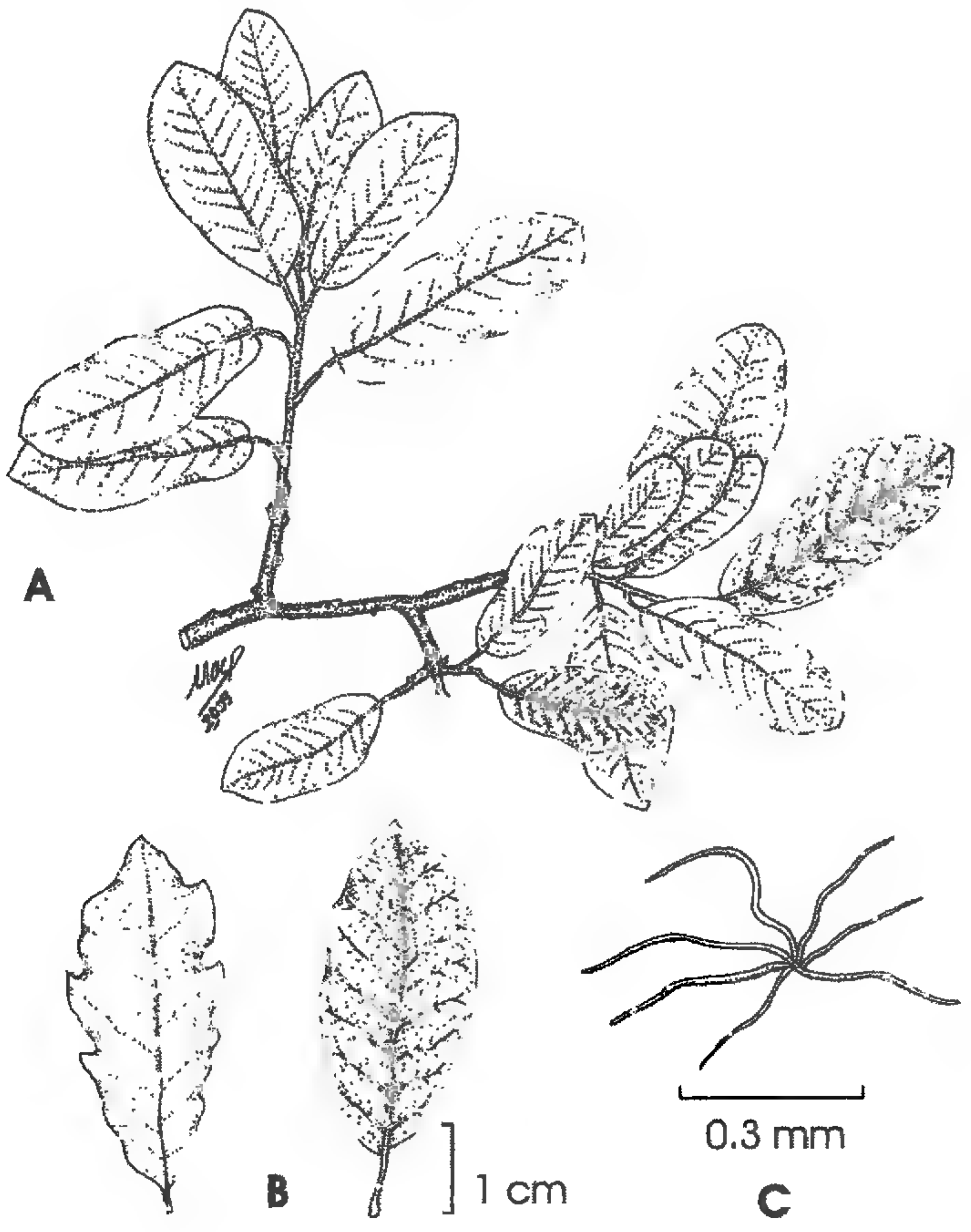
A
B
1 cm
0.3 mm
C

Fig. 3. *Quercus carmenensis*. **A,** rama con hojas; **B,** variación en la hoja; **C,** pelo fasciculado.

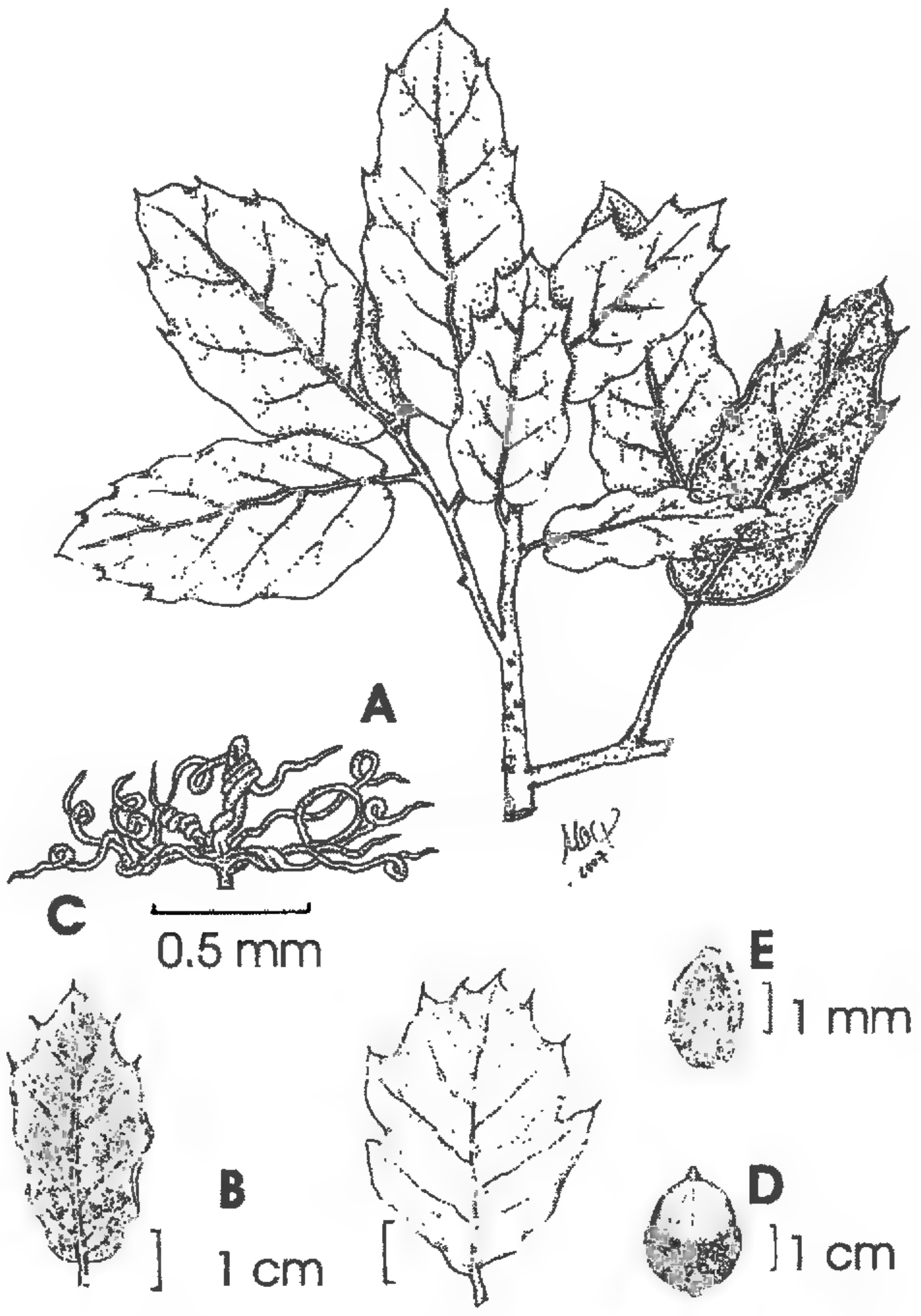
A
C
0.5 mm
E
1 mm
B
1 cm
D
1 cm

Fig. 4. *Quercus coahuilensis*. **A,** rama con hojas; **B,** hoja por el envés y por el haz; **C,** pelo con radios enredados; **D,** bellota; **E,** escama de la cúpula.

toscamente dentado hacia el ápice; haz verde oscuro, con indumento de pelos multirradiados diminutos y esparcidos, envés verde claro, verde amarillento o ligeramente amarillo rojizo, con indumento más prominente; nervaduras 9–12 en cada lado, ramificadas y anastomosadas cerca del margen o terminando en un mucrón en los dientes cuando estos ocurren. Inflorescencias masculinas de 2–3 cm de largo. Inflorescencias femeninas de 1–5 cm de largo de 2–3 flores sobre pedúnculos tomentosos y delgados. Fruto anual, solitario o en pares, subsésil o con un pedúnculo corto; cúpula (inmadura) con escamas agudas, café claro, canescentes; nuez no conocida.

Distribución.—Distribuida principalmente en la Sierra del Carmen, en el noroeste de Coahuila, presente en los bosques mixtos de pino-encino y bosque de encino. Se asocia generalmente con *Cupressus arizonica*, *Pseudotsuga menziesii*, *Pinus strobiformis*, *P. arizonica* var. *stormiae*, *Quercus sideroxyla*, *Q. hypoleucoides*, *Q. rugosa*, *Q. gambelii*, *Garrya ovata*, *Salvia regla*, *Arbutus xalapensis*, *Arctostaphylos pungens*, *Acer grandidentatum* y *Juniperus deppeana*. Se le encuentra en los 2200–2500 m de altitud; presente en la región de la Sierra del Carmen, es poco frecuente en las montañas Chisos de Texas. Crece en valles intermontanos altos y en laderas altas con exposición norte y noroeste, como arbusto rizomatoso, sobre suelos someros y en condiciones de poca humedad, mientras que en cañones húmedos puede ser un árbol de hasta 12 m o más de alto. Considerado como especie endémica del área de Megacoahuila (Villarreal y Encina 2005). Muy relacionado con *Q. undulada*, posiblemente solo se trate de una variación de esta especie.

Notas.—Se reconoce por sus hojas delgadas, casi glabras, obovadas a oblongas de menos de 5 cm de largo, margen entero, con pocos dientes a cortamente lobado, con pelos multirradiados esparcidos.

Material examinado: **Mpio. Ocampo:** El Jardín, exposición N de la sierra del Carmen, 2,200 m, 8 jun 1991, *J.A. Pérez 1765* (ANSM); sierra del Carmen, Moreno canyon, 28°98'N y 102°62'W, 2,465 m, 26 ago 1997, *S. Wood, G. Harper* y *D. Doan-Crider s.n.* (ANSM)

Quercus coahuilensis K. C. Nixon et C.H. Mull., Brittonia 45:150. 1993. (**Fig. 4**). TIPO: MÉXICO. COAHUILA: sierra del Pino, *I. M. Johnston y C.H. Muller 567* (HOLOTIPO: BH-CHM).

Arbusto o raras veces árbol hasta de 8 m de alto, corteza obscura a cuadros; ramillas de 1–1.5 mm de grosor con indumento gris o café rojizo, glabrescente; yemas ovoides, de 3–4 mm de largo, café rojizo, con puberulencia blanquecina hacia el ápice; estípulas subuladas, de 5–6 mm de largo, caedizas. Hojas persistentes; pecíolos de 3–5(–7) mm de largo, con tomento gris persistente; limbos de (1.5–)3–4(–6) cm de largo, de (1–)1.5–3 cm de ancho, estrechamente elípticos a oblongos, o algunas veces obovados, ápice agudo a redondeado terminando en arista corta, base redondeada o por lo común cordada, margen plano o un poco revoluto, con 1–3(–4) pares de dientes cortamente aristados, haz lustroso, verde amarillento o grisáceo, glabro o con indumento amarillento persistente a lo largo de la nervadura media, con pelos diminutos, crispados, fasciculados dejando ver puntos traslúcidos (bajo el microscopio), envés con pelos fasciculados, con radios enredados desde la base, amarillo-blanquecinos, glabrescente, epidermis con ampulas planas, la nervadura media frecuentemente tornándose rosada con la edad; nervaduras 5–7 en cada lado, irregulares y desiguales, impresas en el haz, prominentes en el envés. Inflorescencias masculinas cerca de 2 cm de largo. Inflorescencias femeninas 1 o raramente 2 sobre pedúnculos tomentosos de 1–4 mm de largo. Fruto bianual, solitario o raras veces en pares, subsésil o sobre pedúnculos de 3–4 mm de largo; cúpula hemisférica, de 9–11 mm de ancho, escamas de la cúpula delgadas y flojamente apresadas, glabras y café claro, márgenes con cilios grisáceos, las puntas erosas; nuez ovoides, café claro, con puberulencia densa, incluida la mitad en la cúpula.

Distribución.—Su distribución comprende la sierra del Diablo en el sureste de Chihuahua y en Coahuila se distribuye en sierra del Pino, del Fuste, La Fragua, La Madera, San Marcos, Parras, Jimulco y La Concordia. Forma parte del matorral submontano y del bosque de pino-encino, algunas veces en los bosques de encino, asociándose con *Pinus cembroides*, *P. remota*, *P. arizonica* var. *stormiae*, *Quercus pringlei*, *Q. greggii*, *Q. intricata*, *Q. gravesii*, *Q. invaginata*, *Dasylirion cedrosanum*, *Rhus aromatica*, *R. virens*, *Arbutus xalapensis*, *Arctostaphylos pungens*, *Nolina cespitifera*, *Fraxinus cuspidata*, *F. greggii*, *Prunus serotina*, *Acer grandidentatum*, *Cercocarpus fothergilloides*, *C. montanus* y *Flourensia retinophylla*. Crece entre los 1850–2800 m de altitud, en laderas bajas con exposición norte y noreste en el matorral submontano, en laderas altas con exposición sur en bosques de pino. En las sierras de la Madera y del Pino es más abundante, que en las sierras del sur del estado. Se presenta como arbusto en el matorral submontano, y en el bosque de encino algunas veces se presenta como árbol de hasta 10 m de alto. Considerado como endémico para el área de Megacoahuila (Villarreal y Encina 2005).

Notas.—Se reconoce por sus hojas coriáceas, elípticas a oblongas, menos de 6 cm de largo, usualmente verde amarillentas, margen con dientes cortamente aristados, envés con vención prominente, es característico la presencia de abundantes pelos fasciculados con radios enredados. Escamas de la cúpula delgadas y lisas. Relacionado con *Quercus hintoniorum* y *Q. hypoxantha.*

Material examinado: **Mpio. Parras:** sierra Playa Madero, cañón Pinalosa, ejido Santa Victoria, 25°09'N y 101°34'W, 2,300–2,600 m. 6 jun 1995, *M.A. Carranza y J.A. Encina 153* (ANSM), *M. A Carranza 2210* (ANSM).

Quercus emoryi Torr., W.H. Emory, Not. Milit. Reconn. 151, pl 9. 1848. (**Fig. 5**). Tipo: E.U.A. Texas: *Emory s.n.* (holotipo: NY).

Quercus hastata Liebm., Overs. Danske Vidensk. Selsk. Forh. 1854.
Quercus balsequillana Trel., Mem. Natl. Acad. Sci. 20:123, pl. 220. 1924.
Quercus duraznillo Trel., Mem. Natl. Acad. Sci. 20:122, pl. 220. 1924.

Árbol de (5–)15–20 m de alto, corteza negra áspera y surcada; ramillas de 1–2.5 mm de grosor, café rojizo, con tomento denso, amarillento; yemas de 1.5–3.0 mm de largo, café lustroso; estípulas caedizas, de 5–8 mm de largo. Hojas subpersistentes, gruesas y coriáceas; pecíolos de 5–8(–12) mm de largo, glabrescentes; limbos lanceolados, elíptico-oblongos u ovados, de 3–6(–8) cm de largo y de 1–2.5(–3.5) cm de ancho, verde claro a amarillento, ápice agudo, acuminado y mucronado o con arista corta, base truncada, cordada o redondeada; margen plano o algo revoluto, entero, algo lobulado o con dientes aristados; hojas con haz liso y brillante, glabro o con pelos fasciculados, envés menos brillante, con penachos prominentes de pelos fasciculados estipitados a lo largo de la nervadura media o solo cerca del pecíolo, o glabro; nervaduras de 5–8(–10) en cada lado, ramificadas. Inflorescencias masculinas subsésiles o en pedúnculos cortos, 1–2 flores tomentosas. Fruto anual, solitario o en pares, sobre pedúnculos de 1–2 mm de largo, cúpula de 10 mm de diámetro, hemisférica, escamas de la cúpula apresadas, ovadas y delgadas, ápice glabro, café-castaño, base con puberulencia grisácea, nuez oblonga, elíptica u ovada, de 10–15 mm de largo, de 5–9 mm de ancho, café rojiza, ápice piloso, incluida cerca de la mitad en la cúpula.

Distribución.—Se distribuye desde Arizona, Nuevo México y las montañas del Trans-Pecos en Texas, llegando a México a través de la Sierra Madre Occidental en los estados de Chihuahua y Durango. En Coahuila se encuentra solo en la sierra del Carmen al noroeste del estado, forma parte de los bosques de pino-encino y bosques de encino, asociándose con especies de *Quercus grisea*, *Q. laceyi*, *Q. gravesii*, *Q. mohriana*, *Q. arizonica*, *Q. hypoleucoides*, *Arbutus xalapensis*, *Acer grandidentatum*, *Salvia regla*, *Crataegus greggiana*, *Fraxinus cuspidata*, *Garrya ovata*, *Pinus remota*, *P. arizonica* var. *stormiae*, *Prunus mexicana*, *Juniperus flaccida*, *J. scopulorum* y *Leucaena retusa*. Su rango altitudinal es de 1500–2300 m, sobre laderas medias con suelos derivados de rocas ígneas, con exposición norte, noroeste o en fondos de cañones boscosos con arroyos, donde forma poblaciones más o menos densas. Por su distribución, se considera raro en Coahuila.

Notas.—Se reconoce por sus hojas gruesas, elípticas a oblongas, usualmente menos de 6 cm de largo, verde amarillentas, con apice agudo cortamente aristado, casi glabras con pelos fasciculados en mechones en la nervadura media. Escamas de la cúpula delgadas y lisas.

Material examinado: **Mpios. Acuña y Ocampo:** sierra Madera del Carmen, rancho El Secadero, cañón Poblano, 29°00'N y 102°20'W, 2,100–2,800 m, 20 ago 1994, *M.A. Carranza y J.A. Encina 110* (ANSM).

Quercus fulva Liebm., Overs. Kongel. Danske Vidensk. Selsk. Forh. Medlemmers Arbeider. 183. 1854. (**Fig. 6**). Tipo: MEXICO. Sierra Madre Occidental, *B.C. Seemann 1973* (holotipo: C; isotipo: GH).

Quercus rosei Liebm., Mem. Natl. Acad. Sci. 20:137, pl. 260. 1924.

Arbusto o árbol de (3–)5–8(–10) m de alto; corteza surcada, gris obscura; ramillas de 2.5–5 mm de grosor, con tomento denso amarillento; yemas ovoides a cortamente agudas, de 3–4 mm de largo, pubescentes; estípulas lineares, escariosas. Hojas generalmente deciduas, rígidas, coriáceas y planas; pecíolos de 10–23 mm de largo, tomentosos; limbos elípticos a obovados, suborbiculares o flabelados, de (6–)8–15 cm de largo, de 4–8(–12) cm de ancho, ápice ensanchado, redondeado, obtuso o subagudo, comúnmente aristado, base cordada o redondeada, margen revoluto, cartilaginoso, entero o con 6–11 dientes cortos, cortamente aristados; haz verde pálido poco lustroso, glabro excepto la nervadura media, las nervaduras principales impresas, envés con tomento denso persistente, amarillo-cafesuzco, formado de pelos multirradiados, además de pelos vermiformes; nervaduras 6–10 en cada lado, ascendentes, ramificadas. Inflorescencias masculinas de 2–3 cm de largo, pubescentes. Inflorescencias femeninas con 1–3 flores, usualmente en pares, con pedúnculos de 2–5(–15) mm, largo, tomentosos. Fruto bianual, solitario, o en pares, sobre pedúnculos de de 10–15 mm, cúpula casi hemisférica, de 13–20 mm de ancho, de 6–10mm de largo, con el márgene ligeramente involuto, escamas café con indumento pálido, un poco engrosadas en la base, ápice delgado, apresado; nuez ampliamente ovoides o casi esféricas, de 9–12 mm de largo, de 8–11 mm de ancho, café claro, incluida cerca de la mitad en la cúpula.

Distribución.—Se distribuye en el suroeste de México en los estados de Jalisco, Nayarit y Sinaloa, llegando hasta el norte a través de la Sierra Madre Occidental a Chihuahua y Durango. En la Sierra Madre Oriental se distribuye en Nuevo León y Coahuila. En Coahuila se han encontrado poblaciones relicto en la sierra de Arteaga y sierra de Zapalinamé al sureste del estado. Crece en bosque de pino-encino y bosques de oyamel, asociándose con *Quercus hintoniorum*, *Q. greggii*, *Q. saltillensis*, *Pseudotsuga menziesii*, *Pinus greggii*, *P. teocote*, *P. pseudostrobus*, *P. rudis*, *Prunus serotina*, *Arbutus xalapensis*, *Cupressus arizonica*, *Populus tremuloides*, *Ceanothus buxifolius* y *Garrya ovata*. Se desarrolla en altitudes de 2000–2800 m, en laderas medias con exposición noroeste o en cañones húmedos donde es abundante, su abundancia disminuye en bosques más secos de la exposición sureste. Es poco frecuente en los cañones de Los Lirios y Jamé en la Sierra de Arteaga. La distribución restringida de esta especie la hace aparecer como rara en el área del estado.

Notas.—Se puede reconocer por sus hojas coriáceas, obovadas a suborbiculares de 6–15 cm de largo, verde claro, ápice redondeado y margen con dientes aristados, envés con abundantes pelos simples y multirradiados. Bellotas casi esfericas, cúpula con margen involuto, las escamas de la cúpula con base ensanchada, ligeramente engrosada y ápice corto. Puede confundirse con *Quercus potosina* por la forma de las hojas.

Material examinado: **Mpio. Arteaga:** camino Los Lirios-Laguna de Sanchez, ca. 25°19'N y 100°26'W, 2,200 m, 2 nov. 1994. *J.A. Villarreal* y *J.A. Encina 125* (ANSM); sierra Las Vigas, cañón de Jamé, rancho El Tirol, ca. 12 km al NE de Jamé, 25°26'N y 100°20'W, 2,400–2,600 m, 8 may 1995, *M.A. Carranza* y *J.A. Encina 144* (ANSM). **Mpio. Saltillo:** sierra de Zapalinamé, El Chicharrón, vereda entre el ejido sierra Hermosa y cañón de San Lorenzo, 25°20'N y 100°55'W, 2,532 m, 6 jul 2000, *J.A. Encina* y *R. Cardenas 518* (ANSM).

Quercus fusiformis Small, Bull. Torrey Bot. Club 28:357. 1901. (**Fig. 7**). *Quercus virginiana* Mill. var. *fusiformis* (Small) Sarg., Bot. Gaz. 65:448. 1918. Tipo: E.U.A. Texas: Kerrville, *H. Lacey s.n.* (holotipo: NY).

Quercus oleoides Schltdl. et Cham. var. *quaterna* C.H. Mull., Contr. Texas Res. Found., Bot. Stud. 1:76, tab. 54, 55. 1951.

Arbusto o árbol rizomatoso de 5–10(–12) m de alto; corteza áspera gris o negra; ramillas de 1.5–2.5 mm de grosor, con tomentulo amarillo-rojizo a gris; yemas subglobosas, café rojizas, puberulentas; estípulas de 20–25 mm de largo, subuladas, pubescentes, caedizas. Hojas persistentes, coriáceas; pecíolos de 2–8 mm de largo con indumento denso; limbos oblongos, elípticos u obovados, de 2–7 cm de largo, de 0.5–3 cm de ancho, ápice agudo a redondeado, cortamente mucronado, base cuneada a redondeada, margen entero a irregularmente dentado, algo revoluto o casi plano, haz verde brillante y glabro o con indumento estrellado esparcido, envés gris plateado, con abundantes pelos estrellados, cortos y adpresos, nervaduras 8–10 en cada lado, con algunas intermedios, muy ramificadas, inconspicuas en el haz, poco prominentes en el envés. Inflorescencias masculinas de 3.5–4.5 cm de largo sobre pedúnculos delgados con pelos glandulares esparcidos. Inflorescencias femeninas de 1.5–5.5 cm de largo con 2 a 3 o más flores. Fruto anual, solitario o en grupos de 2 a 3, sobre pedúnculos de 1.5–8 mm de largo, glabros, cúpula de 7–12 mm de ancho, 7–10 mm de alto; escamas ovadas engrosadas en la base, con indumento denso y grisaceo, ápice agudo, rojo oscuro, puberulento; nuez ovoide, subfusiforme a fusiforme de 1.5–2.0 cm de largo, 1–1.3 cm de ancho, glabra y café opaco, incluida un medio a un tercio en la cúpula.

Distribución.—Se distribuye desde Oklahoma y Texas, en México a lo largo de la Sierra Madre Oriental

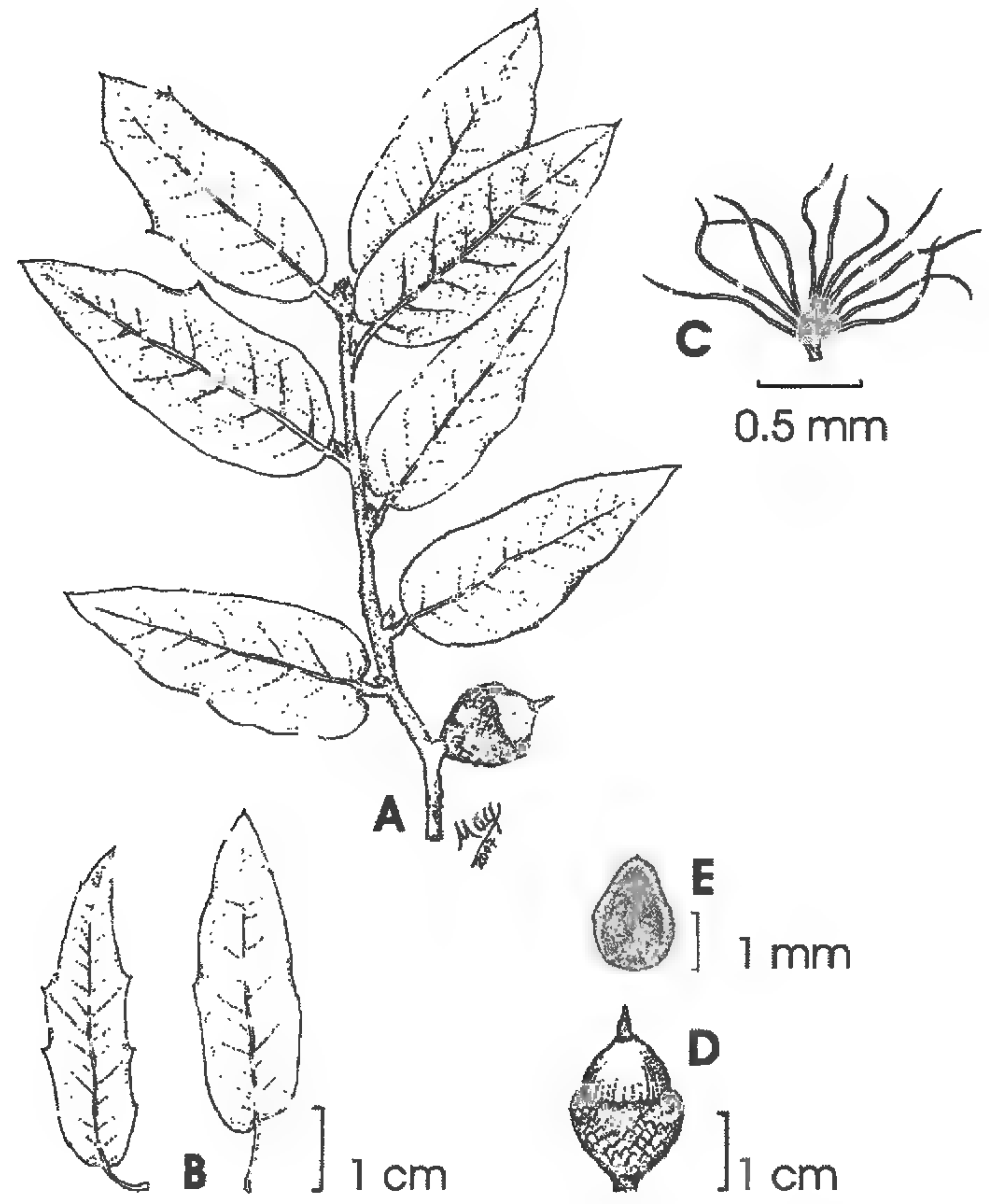
C
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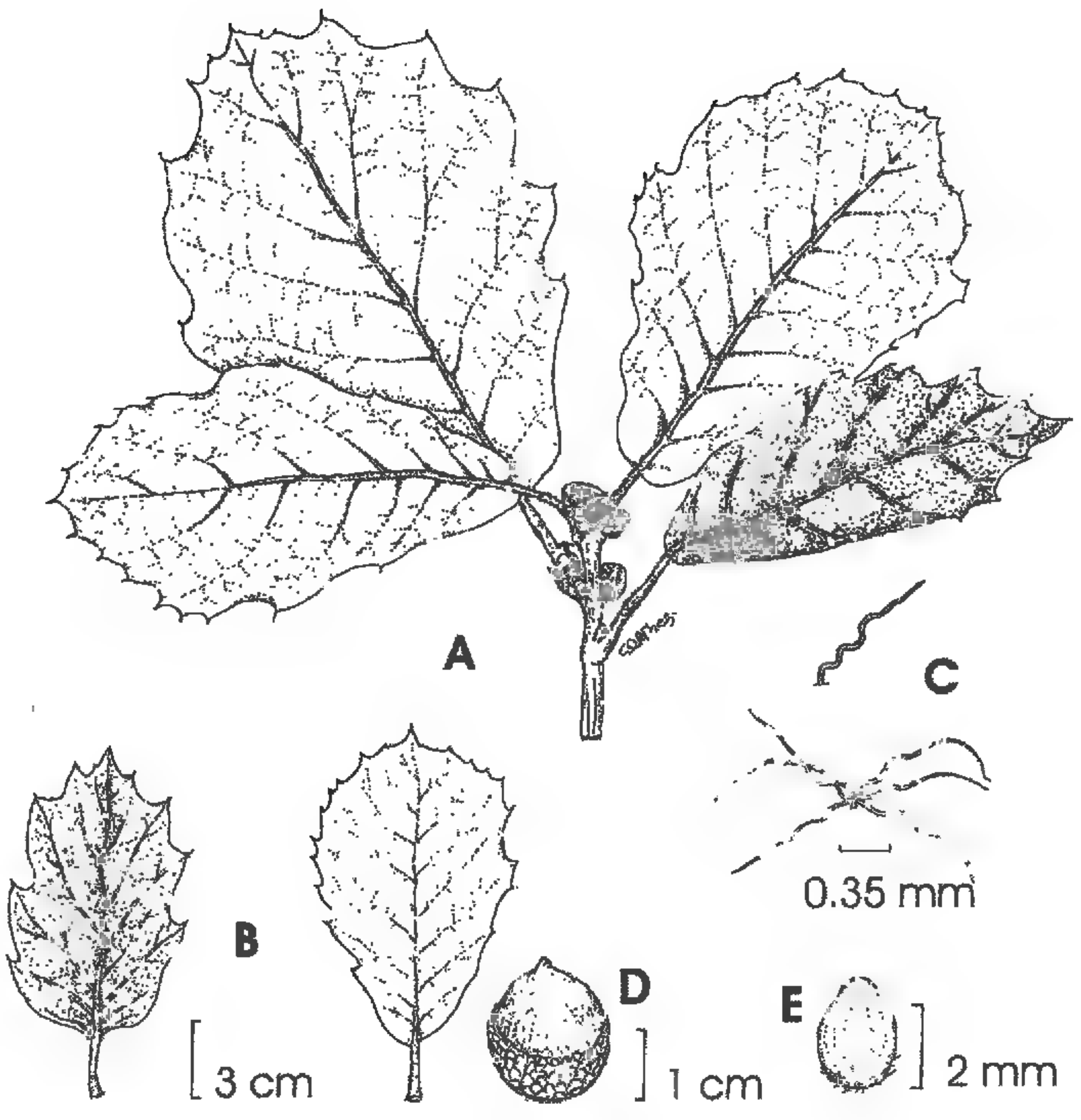
Fig. 5. *Quercus emoryi*. **A,** rama con hojas y bellota; **B,** variación en hoja; **C,** pelo fasciculado estipitado; **D,** bellota; **E,** escama de la cúpula.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1 cm
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Fig. 6. *Quercus fulva*. **A,** rama con hojas y bellotas; **B,** hoja vista por el envés y por el haz; **C,** pelos ramificado y vermiforme; **D,** bellota; **E,** escama de la cúpula.

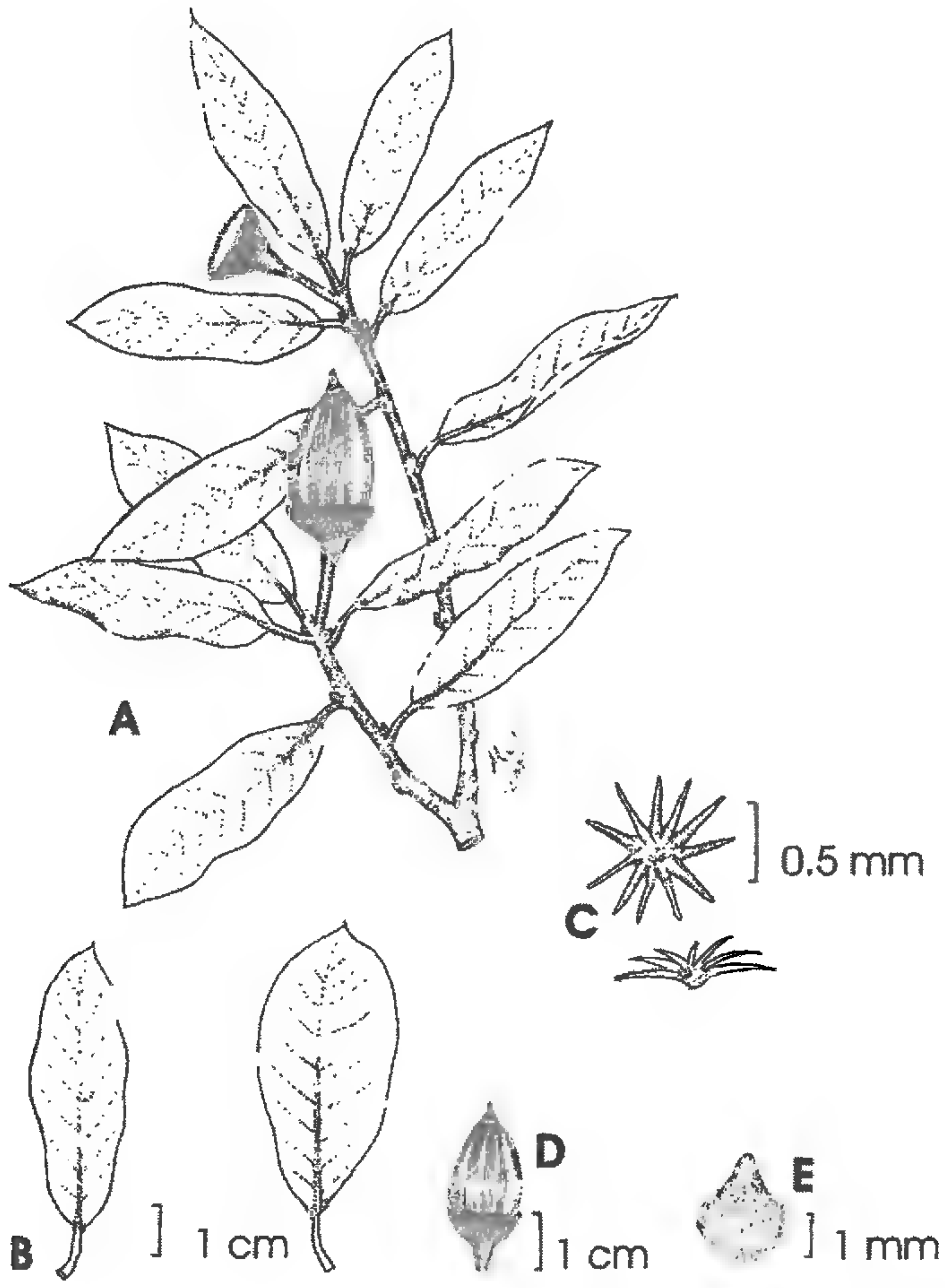
A
0.5 mm
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Fig. 7. *Quercus fusiformis*. **A,** rama con hojas y bellota; **B,** hojas; **C,** pelo estrellado; **D,** bellota; **E,** escama de la cúpula

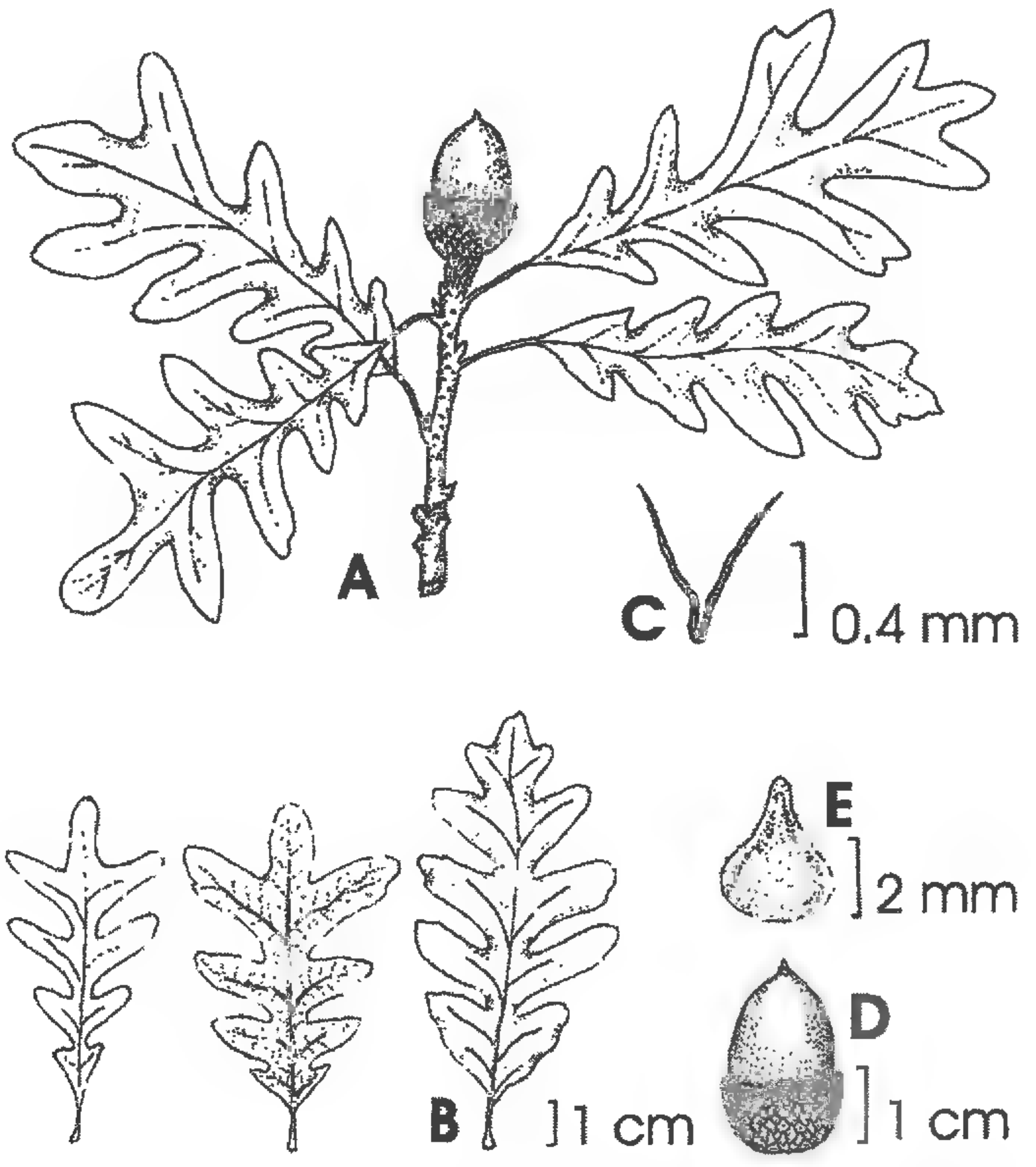
A
C
0.4 mm
E
2 mm
D
B
1 cm
1 cm

Fig. 8. *Quercus gambelii*. **A,** rama con hojas y bellota; **B,** variación en hoja; **C,** pelo fasciculado; **D,** bellota; **E,** escama de la cúpula.

en Nuevo León y Tamaulipas. En Coahuila es encontrado en la Planicie Costera del Golfo, al noreste del estado, en las serranías del Burro, la sierra de Zapalinamé y La Encantada. Se le encuentra en el matorral submontano como una especie arbustiva o bien como un arbolito en la transición con el matorral tamaulipeco, así como en el bosque de encino, asociándose con *Dyospiros texana*, *Bumelia lanuginosa*, *Calia secundiflora*, *Quercus invaginata*, *Q. mohriana*, *Q. sinuata* var. *breviloba*, *Ungnadia speciosa*, *Rhus virens*, *Condalia hookeri*, *C. warnockii*, *Vauquelinia corymbosa* y *Juglans microcarpa*. En el bosque de encino se asocia a *Carya illinoenisis*, *Celtis reticulata* y *Ulmus serotina*. Se presenta hasta los 1900 m de altitud, siendo común entre los 600–1300 m. En la Planicie Costera, donde es más abundante, forma bosques densos en lugares húmedos, prefiere suelos arenosos y profundos o terrenos calizos en laderas bajas, con exposiciones norte y noroeste. En los márgenes de arroyos, ríos o lugares con humedad forma bosques de grandes árboles, su abundancia disminuye hacia las sierras del sur del estado, es raro en el valle de Saltillo. En el municipio de Ramos Arizpe se presentan árboles relicto a través de cauces de arroyos. En el noroeste de Nuevo León es frecuente en el cauce de arroyos intermitentes desde 300 hasta 800 m de altitud, en suelos pedregosos y condiciones de clima árido (Marroquín 1985). Aunque es común en gran parte del estado su existencia se ve amenazada por las actividades del hombre.

Notas.—Se reconoce por las hojas elípticas a obovadas usualmente de menos de 7 cm de largo. Es característico el indumento de pelos estrellados escamosos y apresados, el envés grisáceo y las bellotas sobre pedúnculos de hasta 8 mm de largo, con nuez algo fusiforme, estriada y la cúpula generalmente corta, con escamas con base engrosada.

Material examinado: **Mpio. Acuña:** ejido Las Cuevas, arroyo Las Vacas, 29°18'N y 100°58'W, 284 m, 12 sep 2002, *J.A. Encina* y *O. Saucedo 1057* (ANSM). **Mpio. Candela:** sierra Pajaros Azules, campo Santa María, 4 km al SW de San Guillermo, 27°03'N y 100°53'W, 920 m, 11 nov 1997, *M.A. Carranza et al. 2763* (ANSM), *M.A. Carranza* y *D. Sanchez 2881* (ANSM). cerros cercanos a Candela, ca. 3 km al SE, 26° 50'N y 101°20'W, 1,900 m, *A. Rodríguez* y *M. Martinez 1105* (ANSM). **Mpio. Jiménez:** ejido San Vicente, cerca del río San Diego, 29° 06'N, y 100°55'W, 310 m, 13 sep 2002, *J.A. Encina et al. 1086* (ANSM). **Mpio. Muzquiz:** río San Juan, al E del ejido Morelos, 28°00'N y 101°42'W, 484 m, 3 nov 2005, *J.A. Encina* e *I. Ramirez 1586* (ANSM); sierra Santa Rosa, rancho El Silencio, 27°55'N y 101°50'W, 1,300 m, 2 may 2004, *S. Lara* y *R. Pineda* 103 (ANSM); sierra Santa Rosa, al sur de Muzquiz, 27°49'N y 101°32'W, 760 m, 5 nov 2005, *J.A. Encina* e *I. Ramirez 1618* (ANSM). **Mpio. Piedras Negras:** río San Rodrigo, ejido El Moral, 28°51'N y 100°42'W, 270 m, 12 ago 2001, *M.A. Carranza* e *I. Ramirez* 3521 (ANSM). **Mpio. Ramos Arizpe:** El Carmen, carr. 57, ca. 25 km al N de Saltillo, 25 oct 1994, *J.A. Villarreal* y *M.A. Carranza 7937* (ANSM). **Mpio. Saltillo:** residencial San Lorenzo, al SO de la ciudad, 25°23'N y 101°00'W, 1643 m, 8 jun 1996, *J.A. Encina 177* (ANSM). **Mpio. Villa Unión:** camino de Nava a Villa Unión, rancho La Mota, 28°18'N y 100°44'W, 15 ago 1997, *M. González* y *A. Torres 2924* (ANSM). **Mpio. Zaragoza:** río San Antonio, ca. 12 km al N de Zaragoza (carr. 29), 28°32'N y 101°07'W, 240 m, 27 oct 1999, *J.A. Villarreal* y *M.A. Carranza 8971* (ANSM); río San Rodrigo, ca. 25 km al N de Zaragoza, carr. 29 28°43'N y 100°55'W, 330 m, 9 sep 1995, *M.A. Carranza 2544* (ANSM).

Quercus gambelii Nutt., J. Acad. Natl. Sci. Phila. 1(2):179. 1848. (**Fig. 8**). *Quercus douglasii* Hook. et Arn. var. *gambelii* (Nutt.) A. DC., Prodr. (DC.) 16 (2,1):24. 1864. *Q. undulata* Torr. var. *gambelii* (Nutt.) Engelm., Trans. Acad. Sci. St. Louis 3:393. 1877. Tipo: E.U.A. New Mexico: Santa Fe, *W. Gambel s.n.* (isotipo: GH).

Quercus utahensis Rydb., Bull. N.Y. Bot. Gard. 2:202. 1901.
Quercus novomexicana Rydb., Bull. N.Y. Bot. Gard. 2:208. 1901.
Quercus marshii C.H. Mull., Amer. Midl. Naturalist 18:848. 1937.
Quercus lesueuri C.H. Mull., Amer. Midl. Naturalist 27:476. 1942.

Arbusto o árbol de hasta 20 m de alto; ramillas de 1.5–2.5 mm de grosor, glabras o con pelos fasciculados; yemas ovoides de 3–4 mm de largo, café claro con indumento esparcido; estípulas usualmente caedizas, subuladas, de 4–6 mm de largo. Hojas deciduas, membranosas; pecíolos de 10–25 mm de largo, pubescentes o casi glabros; limbos ovados a obovados u oblongos a elípticos, de (4–)8–12(–16) cm de largo, de (2.5–)4–6(–8) cm de ancho, ápice redondeado, base truncada a cuneada, margen con 4–6 lóbulos en cada lado, oblongos, enteros o dentados, con el ápice redondeado a subagudo, las escotaduras de los lóbulos alcanzando usualmente más de la mitad de distancia a la nervadura media; haz lustroso verde oscuro, glabro o con pelos fasciculados cortos formando un indumento diminuto y esparcido, envés verde opaco algunas veces glauco, con indumento de pelos fasciculados de pocos radios; nervaduras 4–6 en cada lado, muy ramificadas y anastomosadas cerca de la nervadura media, un poco salientes en el haz, prominentes en el envés.

Inflorescencias masculinas de 2–3 cm de largo, con tomento esparcido. Inflorescencias femeninas de 3–8 mm de largo, con 1–3 flores en la parte terminal. Fruto anual, solitario o en pares, subsésil o sobre pedúnculos hasta de 1 cm de largo; cúpula de 7–15 mm de ancho, de 5–7 mm de alto; escamas de la cúpula ovadas, engrosado-tuberculadas, ápice corto, angosto, base con indumento gris; nuez ovoide a elípsoide, de 12–15 mm de largo, de 8–10 mm de ancho, café clara, casi glabra, incluida cerca de un medio en la cúpula.

Distribución.—Se distribuye en las montañas Rocallosas en los estados de Wyoming, Utah, Nevada, Arizona, Colorado, Nuevo México y oeste de Texas, llega hasta la Sierra Madre Occidental al norte de Chihuahua y Sonora. En Coahuila se le encuentra en las sierras del Carmen y La Madera, en el norte y centro del estado. Se localiza en bosques de encino y de pino-encino, asociándose con *Quercus carmenensis*, *Q. arizonica*, *Q. greggii*, *Pseudotsuga menziesii*, *Pinus arizonica* var. *stormiae*, *P. strobiformis*, *Abies durangensis* var. *coahuilensis*, *Populus tremuloides*, *Arctostaphylos pungens*, *Arbutus xalapensis*, *Acer grandidentatum* y *Cornus stolonifera*. Se localiza entre 2500–3000 m de altura. En Coahuila presenta un alto grado de aislamiento, restringiéndose para algunas de las cimas montañosas del centro y norte, crece cerca de laderas en exposición noroeste y valles intermontanos altos. La especie es rara en el área del estado.

Notas.—Se reconoce fácilmente por sus hojas delgadas, verde obscuro, oblongas, elípticas u ovadas, con 4–6 pares de lóbulos, casi glabras. Escamas de la cúpula con ápice estrecho. Solo se le conoce de las sierras del Carmen y la Madera.

Material examinado: **Mpio. Acuña:** sierra del Carmen, roadside collection between El Uno and Main Camp., 2,300 m, 25 ago 1997, *S. Wood, G. Harper y D. Doan-Crider s.n.* (ANSM).

Quercus gravesii Sudw., Check List For. Trees U.S. 86. 1927. (**Fig. 9**).

Quercus texana Buckley var. *chesosensis* Sarg., Bot. Gaz. 65:423. 1918.
Quercus texana Buckley var. *stellipila* Sarg., Bot. Gaz. 65:424. 1918.
Quercus stellipila (Sarg.) Parks ex Cory, Rhodora 38:405. 1936.
Quercus chesosensis (Sarg.) C.H. Mull., Amer. Midl. Naturalist 18:850. 1937.
Quercus shumardii Buckley var. *microcarpa* (Torr.) Shinners, Field & Lab. 24:37. 1956.

Árbol de hasta 13 m de alto; corteza negra, áspera y surcada; ramillas de 1–2 mm de grosor, café rojizas con pocas lenticelas, con indumento amarillento, glabrescentes; yemas agudas de 3–6 mm de largo, café rojizo; estípulas caedizas, de 5–10 mm de largo. Hojas deciduas, delgadas y coriáceas; pecíolos hasta de 15 mm de largo, glabrescentes; limbos ovados u obovados, de (5–)8–12(–14) cm de largo, de (4–)6–8(–12) cm de ancho, ápice agudo a obtuso, base cuneada a redondeada, margen con 2–3 lóbulos en cada lado con sinuosidades profundas y abiertas, alcanzando solamente la mitad a tres cuartos de distancia a la nervadura media, los lóbulos cuneados y enteros con pocos dientes en la parte distal, los lóbulos terminales elongados, dentados o ligeramente lobulados, terminados en aristas, haz verde claro, lustroso, glabro, con indumento escaso de pelos fasciculados, envés verde claro o cobrizo, opaco, glabro o con algo de indumento fasciculado diminuto; nervaduras una en cada lóbulo, salientes en ambas superficies. Inflorescencias masculinas de 6–7 cm de largo, con pelos fasciculados esparcidos. Inflorescencias femeninas de hasta 15 mm largo, 1–3 flores sobre pedúnculos glabrescentes café rojizo. Fruto bianual, solitario o en pares, sobre pedúnculos de 4–12 mm de largo, cúpula de 1–1.5 cm de ancho, de 5–8 mm de alto, hemisférica; escamas de la cúpula redondeadas, café claro, con indumento diminuto, denso, margen ciliado; nuez ovoide, de 12–15 mm de largo y de 8–10 mm de ancho, café claro opaco, con puberulencia densa, glabrescente, incluida de un tercio a un medio en la cúpula.

Distribución.—Se distribuye en las montañas del Trans-Pecos al oeste de Texas y la confluencia de los ríos Bravo y Pecos, llega hasta Coahuila encontrándose en la mayoría de las montañas del norte, noroeste y del centro del estado (sierra del Carmen, La Encantada, del Burro, La Madera, La Gloria y La Paila) y en forma aislada se distribuye en la sierra de Zapalinamé, al sureste del estado. Se reportan híbridos con *Q. coahuilensis* para la sierra de la Madera. El híbrido presenta hojas como *Q. gravesii* con lóbulos cortos a dientes cortos, aristados y envés ampulado (Muller, en prensa). Crece en el bosque de pino-encino y bosque de encino asociándose con las siguientes especies: *Quercus laceyi*, *Q. hypoleucoides*, *Q. grisea*, *Q. emoryi*, *Q.*

invaginata, *Q. mohriana*, *Q. muehlenbergii*, *Pinus arizonica* var. *stormiae*, *P. strobiformis*, *P. remota*, *Juniperus flaccida*, *Cupressus arizonica*, *Prunus serotina*, *Acer grandidentatum*, *Arbutus xalapensis*, *Cercis canadensis*, *Cornus stolonifera*, *Leucaena retusa*, *Fraxinus berlanderiana*, en lugares con abundante humedad se encuentra asociado con *Ungnadia speciosa*, *Prunus serotina*, *Juglans microcarpa*, *J. mollis* y *Tilia mexicana*.Se desarrolla en elevaciones entre 1200–2500 m, sobre laderas medias y altas, con exposición norte y noroeste, en valles intermontanos o al lado de arroyos en cañones húmedos, frecuentemente formando bosques densos. La especie es considerada endémica para el área de Coahuila.

Notas.—Se reconoce fácilmente por sus hojas delgadas, verde claro, casi glabras, ovadas a obovadas, usualmente de 8–12 cm de largo, con 2–3 pares de lóbulos terminados en aristas prominentes. Escamas de la cúpula planas.Presenta semejanzas en morfología de la hoja con *Q. canbyi*.

Material examinado: **Mpio. Acuña:** serranias del Burro, rancho El Bonito, 29°01'N y 102°07'W, 1,625 m, 19 sep 1977, *D. Riskind* y *C.H. Muller 2201* (ANSM, TEX). **Mpio. Candela:** sierra Pajaros Azules, campo Santa María, cañada Las Sabinillas, 27°02'N y 100°54'W, 1,300 m, 12 nov 1997, *M.A. Carranza et al. 2819* (ANSM). **Mpio. Castaños:** sierra La Gavia, rancho La Gavia, 26°10'N y 101°18'W, 1,295 m, 10 ago 1995, *M.A. Carranza* y *J.A. Encina 170* (ANSM). **Mpio. Cuatro Cienegas:** sierra San Marcos, cañón Grande, ejido Estanque de Norias, 27°40'N y 102°50'W, 1,550 m, 1 oct 1993, *M.A. Carranza* y *J.A. Encina 1683* (ANSM); sierra de La Madera, cañón Charreteras, rancho Charreteras, 27°12'N y 102°42'W, 1,750 m, 15 sep 1993, *J. A. Villarreal* y *M.A. Carranza 7323* (ANSM). **Mpio. Muzquiz:** sierra Santa Rosa, ejido La Esperanza, 28°08'N y 102°00'W, 1,300 m, 8 sep 1990, *R. Vasquez 110* (ANSM); sierra Santa Rosa (La Babia), rancho La Babia, cañón Rincón de María, 28°27'N y 102°04'W, 1,450 m, 21 ago 1999, *M.A. Carranza et al. 3077* (ANSM). **Mpio. Ocampo:** sierra del Pino, ejido Acebuches, cañón La Vaca, 28°15'N y 102°59'W, 1,850 m, 1 oct 2003, *M.A. Carranza* e *I. Ramirez 3958* (ANSM); sierra Maderas del Carmen, rancho El Secadero, 29°00'N y 102°20'W, 2,100 m, 20 ago 1994, *M.A. Carranza* y *J.A. Encina 2033* (ANSM); Sierra La Encantada, cuesta de Malena 28°35'N y 102°10'W, 21 ago 1994, *M.A. Carranza* y *J.A. Encina 113* (ANSM). **Mpio. Ramos Arizpe:** sierra de La Paila, ejido El Cedral, 26°02'N y 101°23'W, 1,300 m, 20 ago 1987, *J.A. Villarreal* y *M.A. Carranza* 3939 (ANSM). **Mpio. Zaragoza:** rancho La Escondida, 28°53'N y 101°57'W, 1,200 m, 6 may 2003, *M. Guerrero* y *O. Ballesteros s.n.* (ANSM)

Quercus greggii (A. DC.) Trel., Contr. U.S. Natl. Herb. 23:185. 1922. (**Fig. 10**). *Quercus reticulata* Kunth var. *greggii* A. DC., Prodr. (DC.) 16 (2.1):34. 1864. *Quercus greggii* (A. DC.) Trel. f. *subglabra* C.H. Mull. in I.M. Johnst., J. Arnold Arbor. 25:440. 1944. TIPO: MÉXICO. COAHUILA: Arteaga, San Antonio de las Alazanas, *J. Gregg 389* (HOLOTIPO: US). *Q. loeseneri* Trel., Mem. Natl. Acad. Sci. 20:79, pl. 110. 1924.

Quercus derrumbaderoensis C.H. Mull., Amer. Midl. Naturalist 27:471. 1942.

Arbusto o arbolito de 0.5–5(–12) m de alto; corteza gris escamosa; ramillas de 1.5–3 mm de grosor, con pelos fasciculados diminutos, densos, café amarillento; yemas subredondas, de 1 mm de diámetro; estípulas lanceoladas, pubescentes de 4–5 mm de largo. Hojas persistentes, coriáceas; pecíolos de 3–6(–10) mm de largo, pubescentes; limbos ovados, obovado-elípticos u oblongos de (1.5–)2–3(–5) cm de largo, de (1–)1.5–4 cm de ancho, ápice obtuso a casi redondeado, base redondeada a cordada, margen entero a ondulado, engrosado, revoluto, con 3–5 dientes mucronados o lóbulos poco profundos en la mitad distal de la hoja, haz verde oscuro, algo lustroso con indumento en las nervaduras, envés densamente lanoso-tomentoso, con pelos fasciculados y rizados, café amarillento y pelos glandulares; nervaduras prominentes, 5–6(–8) por cada lado, ramificadas, impresas en el haz y elevadas en el envés. Inflorescencias masculinas de 3–4.5 cm de largo, con pelos fasciculados. Inflorescencias femeninas de 1–3.5 cm de largo con 2–4 flores. Fruto anual, en grupos de 1–4, pedúnculo tomentoso, de 5–30 mm de largo; cúpula hemisférica de 10–15(–20) mm de diámetro, escamas café rojizo, base engrosada y pubescente, ápice delgado, apresado, las escamas del margen rebasando el borde; nuez ovoide-elíptica, de 10–17 mm de largo, glabra, incluida alrededor de un medio o más en la cúpula.

Distribución.—Se distribuye desde el centro-este de México, en los estados de Hidalgo, Puebla y San Luis Potosí, llega al noreste a través de la Sierra Madre Oriental hasta Nuevo León, en Coahuila se encuentra en las montañas del centro, sur y sureste del estado, en las sierras de La Madera, de Parras, La Concordia, de Zapalinamé y de Arteaga. Es un componente de los bosques de pino-encino, encino, oyamel y en la vegetación alpina-subalpina. Se asocia principalmente con *Quercus hintoniorum*, *Q. saltillensis*, *Q. coahuilensis*, *Pinus pseudostrobus*, *P. culminicola*, *P. arizonica* var. *stormiae*, *P. rudis*, *P. strobiformis*, *Cornus stolonifera*, *Garrya ovata*, *Arctostaphylos pungens*, *Pseudotsuga menziesii*, *Abies durangensis* var. *coahuilensis*, *Acer grandidentatum*, *Ceanothus buxifolius*, *Arbutus xalapensis* y *Prunus serotina*. Se localiza entre los 2400–3400 m de altitud, en cimas montañosas, laderas altas con exposición norte y noroeste, se encuentra además en cañones boscosos húmedos y semihúmedos o en terrenos semisecos, sus hábitos de crecimiento varían desde tipo arbustivo o arbolito de 3–5 m, disminuyendo su altura con la altitud. Es una especie muy abundante en las montañas del sureste del estado y frecuente en la Sierra de la Madera. La población de la sierra de la Madera reportada como *Q. greggii* f. *subglabra*, es al parecer una introgresion de la especie con *Q. pringlei* (Muller, en prensa). En bosques de oyamel es un arbusto rizomatoso que junto con otros encinos y arbustivas forman un matorral denso y de difícil acceso, denominado chaparral por Marroquín (1976) y Valdés y Aguilar (1983). Especie común en las áreas donde habita.

Notas.—Se caracteriza por las hojas coriáceas, ovadas a elípticas u oblongas, de menos de 5 cm de largo, margen entero o con 3–6 pares de dientes mucronados, haz verde oscuro y envés con indumento café-amarillento. Escamas de la cúpula con base engrosada. Puede confundirse con *Quercus coahuilensis*, *Q. hintoniorum* y *Q. hypoxantha*.

Material examinado: **Mpio. Arteaga:** sierra de Arteaga, El Coahuilón, 2,940 m, 14 may 2000, *G.B. Hinton 27538* (ANSM); Los Oyameles, 2,800 m, 6 mar 2003, *E. Estrada 15271ª* (ANSM, CFNL); sierra Hermosa (sierra de Artega), cerro La Campana, 2,470 m, 27 jun 1979, *L. Arce s.n.* (ANSM); La Siberia, 25°15'N y 100°29'W, 2,800 m, 6 sep 1994. *J.A. Villarreal et al. 116* (ANSM); Las Vigas, cañón de Jamé, rancho El Tirol, 25°26'N y 100°30'W, 2,450 m, 8 may 1995, *M.A. Carranza* y *J.A. Encina 2164* (ANSM). **Mpio. Cuatro Cienegas:** sierra de La Madera, cañón del Invierno (El Infiernillo), 27°04'N y 102°28'W, 2,750 m, 28 ago 1974, *T. Wendt 634* (ANSM). **Mpio. General Cepeda:** sierra La Concordia-Pilote de Fierro, ejido La Casita, 25°10'N y 101°25'W, 2,950 m, 24 oct 1991, *M.A. Carranza* y *L. García 1252* (ANSM). **Mpio. Parras:** sierra de Parras, arroyo Seco, 2,000 m, 12 abr 1981, *A. Rodríguez* y *M.A. Carranza 283* (ANSM). **Mpio. Saltillo:** sierra de Zapalinamé, El Penitente, 25°21'N y 100°54'W, 2,710 m, 4 may 2004, *J.A. Encina et al. 1271* (ANSM); sierra La Concordia (sierra Catana), 25°15'N y 101°12'W. 2,750 m, 29 ago 1992, *J.A. Villarreal et al. 6556d* (ANSM).

Quercus grisea Liebm., Overs. Kongel. Danske Vidensk. Selsk. Forh. Medlemmers Arbeider. 171. 1854. (**Fig. 11**). TIPO: E.U.A. TEXAS: *C. Wright 665* (HOLOTIPO: G-DC; ISOTIPOS: GH, MO, NY).

Arbusto o árbol de 3–7(–10) m de alto, corteza fisurada, gris claro; ramillas de 1–2 mm de grosor, con indumento gris amarillento, glabrescente; yemas redondeado-ovoides de 2 mm de largo, glabras, café rojizo; estípulas persistentes, subuladas o filiformes, de 3–6 mm de largo, pubescentes. Hojas deciduas o subpersistentes, coriáceas; pecíolos de 3–10 mm de largo, tomentosos; limbos oblongos a elípticos u ovados, de (1.5–)3–5(–8) cm de largo, de (0.5–)1.5–3(–4) cm de ancho, ápice agudo a obtuso, mucronado, base cordada, redondeada o cuneada, margen un poco revoluto, entero o con dientes cortos terminando en un mucrón, haz verde opaco, glabro, con pelos multirradiados muy esparcidos y diminutos, envés verde grisáceo o blanquecino, opaco, con pelos multirradiados densos; nervaduras 6 a 10 en cada lado, muy ramificadas y anastomosadas, un poco salientes en el haz, prominentes en el envés. Inflorescencias masculinas de 2–4(–7) cm de largo, flores vellosas. Inflorescencias femeninas de 0.5–4 cm de largo con 1–8 flores tomentulosas. Fruto anual, solitario o en pares, subsésiles o en pedúnculos de hasta 2–3 cm de largo; cúpulas hemisféricas, de 8–15 mm de ancho, de 4–10 mm de alto, escamas de la cúpula ovadas a oblongas, base ligeramente engrosada a tuberculada, con tomento canescente, ápice delgado, apresado, café rojizo con puberulencia esparcida, las escamas del margen de la cúpula elongadas; nuez ovoide o elipsoide, de 12–18 mm de largo, de 8–12 mm de ancho, café claro, glabra o con indumento fino, incluida cerca de la mitad en la cúpula.

Distribución.—Se distribuye desde Arizona, Nuevo México, oeste de Texas, noroeste de Nuevo León, norte de Chihuahua, Durango, sur de Zacatecas y norte de Jalisco. En Coahuila se encuentra al norte y centro del estado en las sierras del Carmen, Las Cruces, del Fuste, del Pino, La Encantada, La Paila, de Arteaga y Zapalinamé, en matorral submontano, bosque de encino y de pino-encino. Se asocia con *Pinus remota*, *P. arizonica* var. *stormiae*, *Acer grandidentatum*, *Quercus emoryi*, *Q. mohriana*, *Q. gravesii*, *Q. intricata*, *Q. laceyi*, *Juniperus flaccida*, *Crataegus greggiana*, *Ungnadia speciosa*, *Garrya ovata*, *Fraxinus cuspidata*, *F. berlanderiana*, *Dasylirion cedrosanum*, *Cercocarpus montanus* y *Arbutus xalapensis*. Crece entre los 1400–2350 m de altitud, en macizos montañosos con laderas bajas, colinas rocosas secas, valles o en fondos de cañones con suelos de rocas ígneas o calizas. Es frecuente en exposiciones noroeste o suroeste de las montañas del norte y común en la sierra de La Paila, así como en algunas localidades en las sierras del sureste. A orillas de arroyos generalmente forma colonias pequeñas de arbolitos o árboles de hasta 10 m y en colinas secas forma matorrales

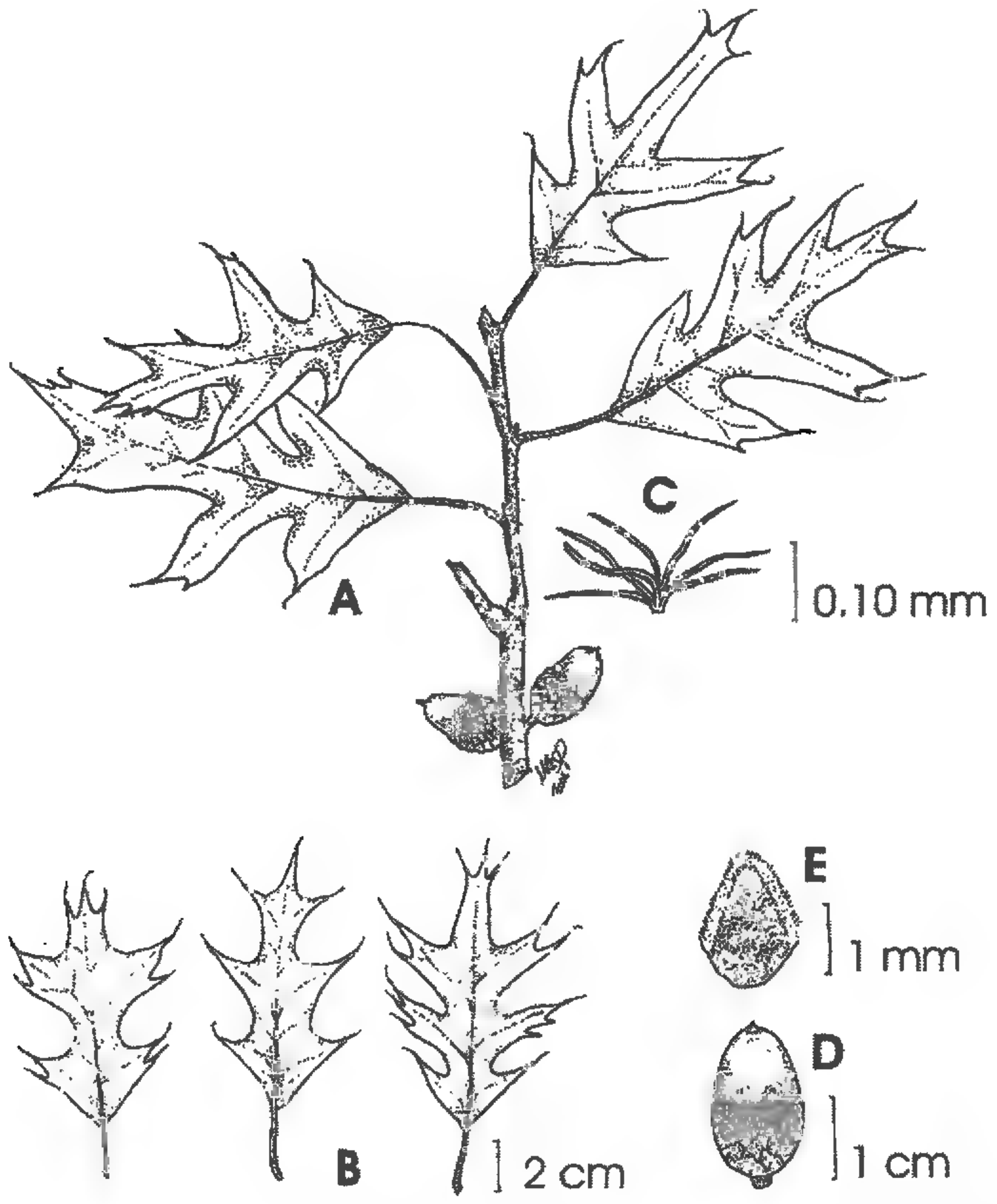
A
C
0.10 mm
E
1 mm
D
1 cm
B
2 cm

Fig. 9. *Quercus gravesii*. A, rama con hojas y bellotas; B, variación en hoja; C, pelo fasciculado; D, bellota; E, escama de la cúpula.

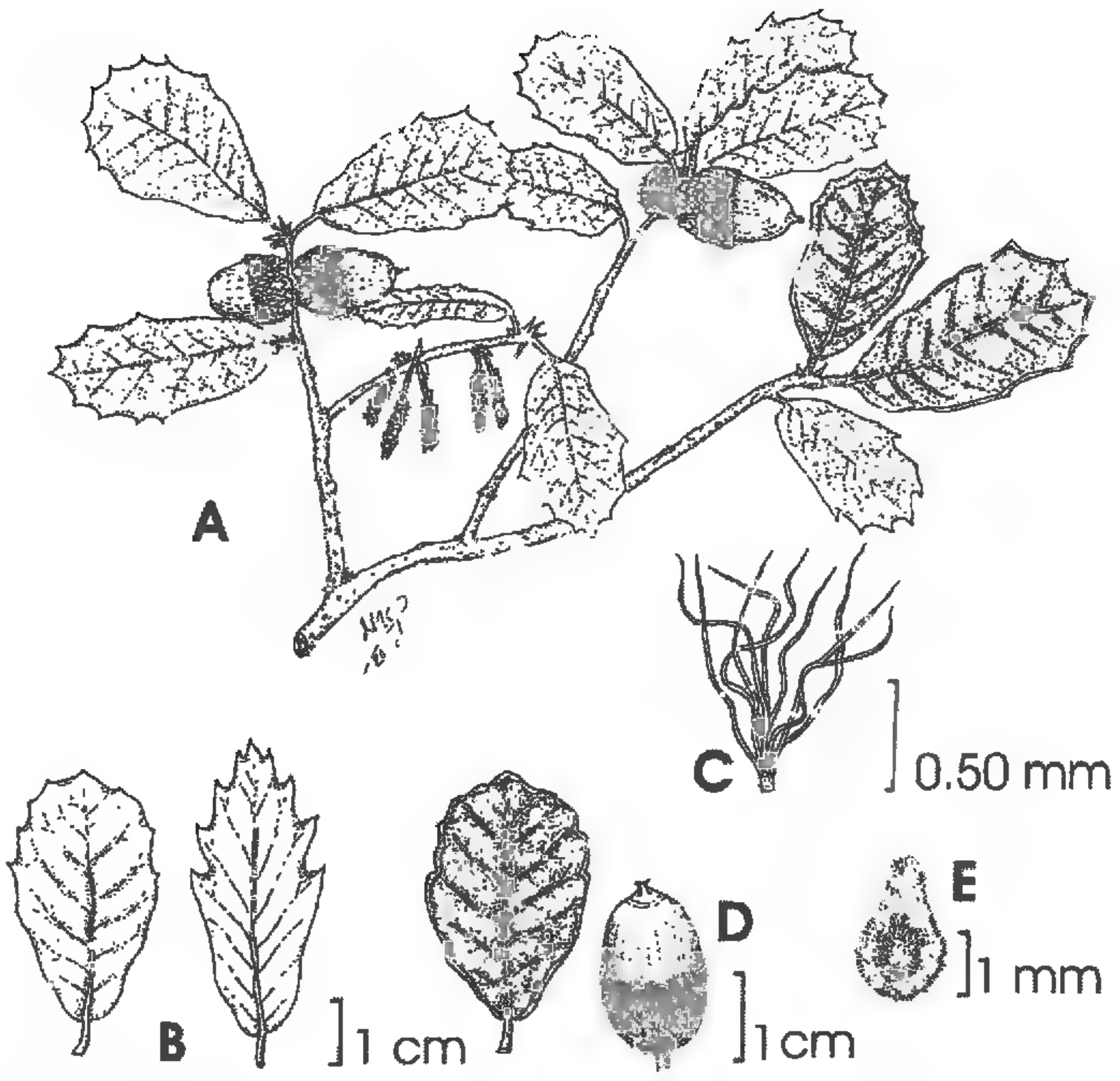
A
C
0.50 mm
E
1 mm
D
1cm
B
1 cm

Fig. 10. *Quercus greggii*. A, rama con hojas, amentos y bellotas; B, variación en hoja; C, pelo fasciculado estipitado; D, bellota; E, escama de la cúpula.

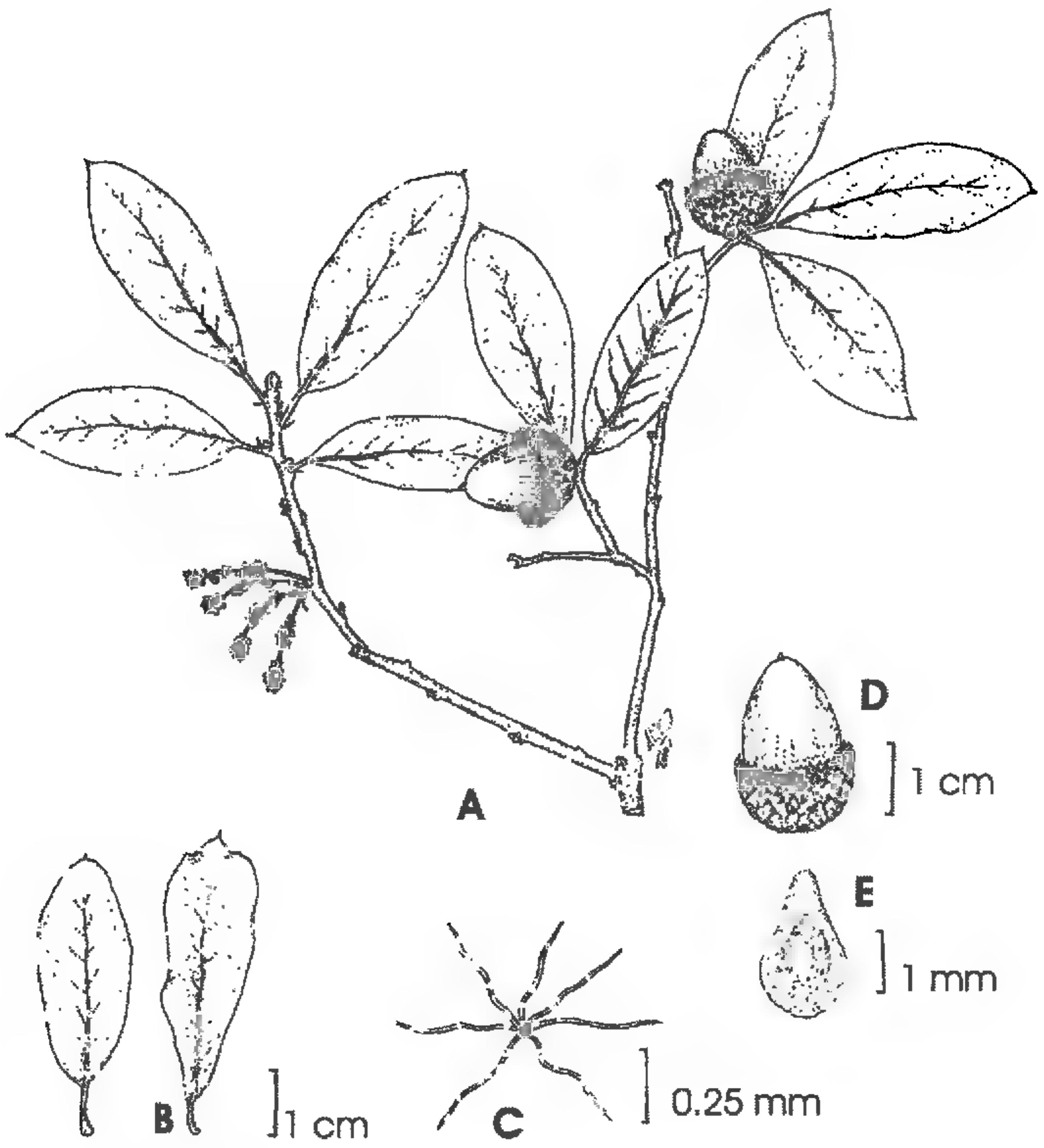
D
1 cm
A
E
1 mm
B
1 cm
C
0.25 mm

Fig. 11. *Quercus grisea*. A, rama con hojas, amentos y bellotas; B, variación en hoja; C, pelo multirradiado; D, bellota; E, escama de la cúpula.

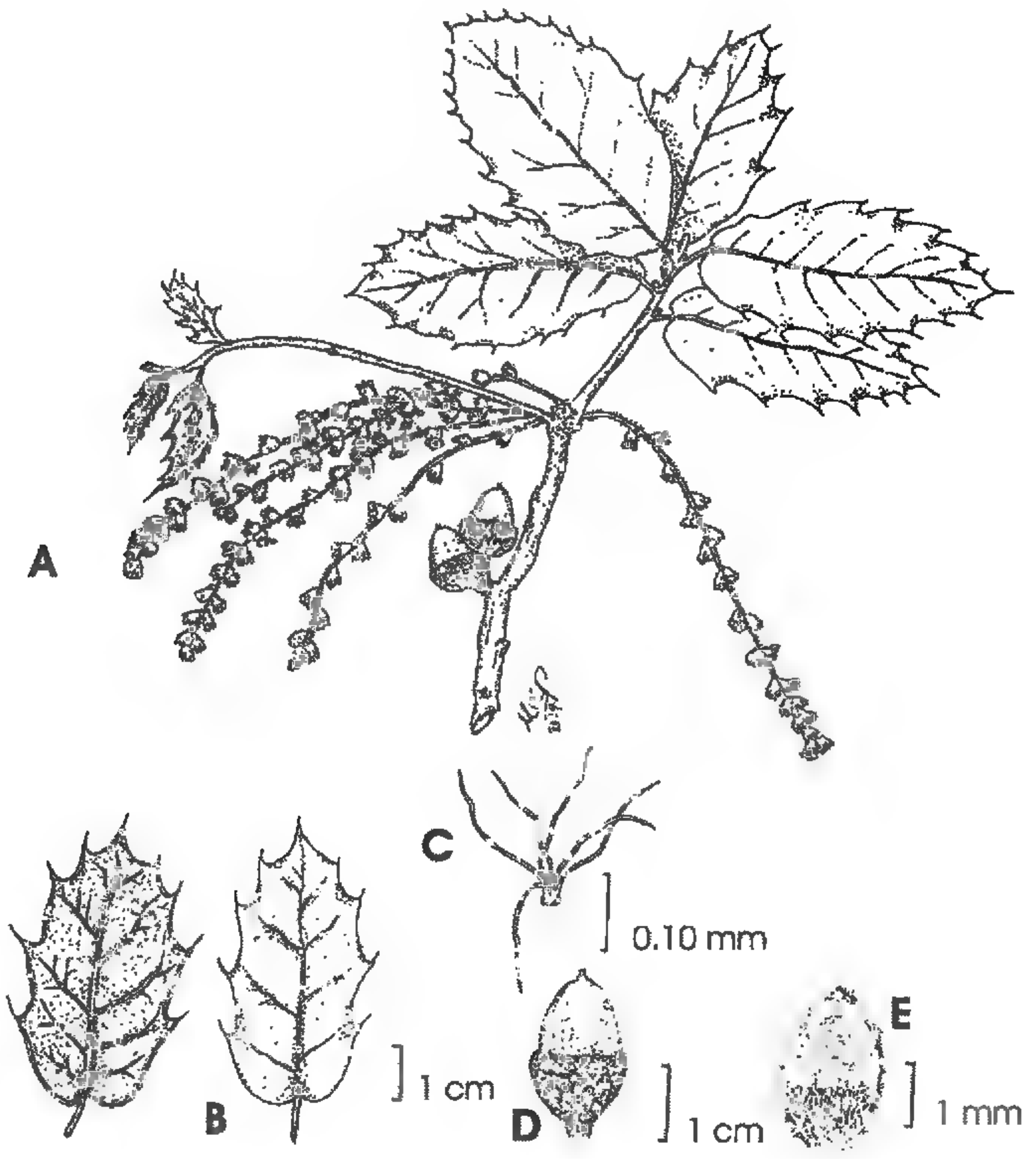
A
C
0.10 mm
E
B
1 cm
D
1 cm
1 mm

Fig. 12. *Quercus hintoniorum*. A, rama con hojas, amentos y bellotas; B, hoja vista por el envés y el haz; C, pelo fasciculado; D, bellota; E, escama de la cúpula.

densos de 1–3 m de alto. Especie común en las áreas donde habita.

Notas.—Se reconoce por las hojas coriáceas, elípticas a lanceoladas, usualmente de menos de 8 cm de largo, ápice agudo y mucronado, margen generalmente entero co con pocos dientes mucronados, haz verde opaco y envés grisáceo con indumento denso de pelos multirradiados. Escamas de la cúpula con base engrosada. Se le puede confundir con *Quercus mohriana*.

Material examinado: **Mpio. Candela:** sierra de Pajaros Azules, campo Santa María, 27°01'N y 100°50'W, 3 jun 1997, *P. Cruz* 07 (ANSM). **Mpio. General Cepeda:** sierra La Concordia, 4.5 km al NW del ejido La Casita, 25°14'N y 101°25'W, 10 oct 1996, *J.A. Encina* y *J. Zavala* 259 (ANSM). **Mpio. Muzquiz:** sierra del Carmen, Los Lirios, cañón con arroyo temporal, 25°54'N y 102°30'W, 15 sep 1992, *J.A. Villarreal* y *M.A. Carranza 7042* (ANSM). **Mpio. Ocampo:** sierra del Pino, ejido Acebuches, cañón La Vaca, 28°15'N y 102°59'W, 2 oct 2003, *M.A. Carranza* e *I. Ramirez 3957* (ANSM); sierra La Encantada, cuesta Malena, 28°54'N y 102°30'W, 29 mar 1992, *M.A. Carranza* y *J. Noriega 1515* (ANSM). **Mpio. Parras:** sierra Playa Madero, cañón Pinalosa, ejido Santa Victoria, 25°09'N y 101°24'W, 6 jun 1995, *M.A. Carranza* y *J.A. Encina 150* (ANSM). **Mpio. Ramos Arizpe:** sierra de La Paila, ejido El Cedral, valle Loma Prieta, 25°28'N y 101°35'W, 1 may 1991, *J.A. Villarreal et al. 5825* (ANSM). **Mpio. Saltillo:** sierra de Zapalinamé, cañón Boca Negra, por el camino del Cuatro, 25°21'N y 100°55'W, 21 ago 2004, *J.A. Encina et al. 1354* (ANSM); Mipo. Zaragoza, rancho La Escondida, 28°55'N y 101°51'W, 6 may 2003, *M. Guerrero* y *O. Ballesteros s.n.* (ANSM).

Quercus hintoniorum K. C. Nixon et C.H. Mull., Brittonia 45:147. 1993. (**Fig. 12**). Tipo: MÉXICO. Coahuila: Los Lirios, *R.M. Straw y M. Forman 1361* (holotipo: US).

Arbusto rizomatoso o arbolito de hasta 5 m de alto, corteza gris oscura, lisa; ramillas café rojizas de 1–2 mm de grosor, con puberulencia esparcida, volviéndose glabras; yemas ovoides, cerca de 2 mm de largo, café oscuro; estípulas lineares, cerca de 5 mm de largo. Hojas subpersistentes, pecíolos de 3–6 mm de largo, glabros, rojizos; limbos elípticos u obovados, de (2–)3–6 cm de largo, de 1–4 cm de ancho, ápice redondeado o subagudo, base fuertemente cordada, raras veces cuneada, margen plano o revoluto, sinuado, sublobulado, raras veces entero, con (4–)5–8 dientes irregulares en cada lado, especialmente hacia el ápice de la hoja, dientes con aristas de 1–2 mm largo, la hoja frecuentemente conduplicada arriba del pecíolo, haz verde oscuro, moderadamente lustroso con pelos fasciculados esparcidos, glabrescente, envés con pelos glandulares uniseriados y pelos fasciculados, estipitados y esparcidos, la superficie claramente visible, con pequeños parches densos de pelos fasciculados y erectos restringidos a lo largo de las axilas de la nervadura media y las nervaduras secundarias; nervaduras laterales 4–5 en cada lado, irregulares y desiguales, frecuentemente ramificándose cerca del margen. Inflorescencias masculinas de 5–6 cm de largo. Inflorescencias femeninas de 1 o 2 flores sobre pedúnculos tomentosos de 2–7 mm de largo. Fruto bianual, cúpula turbinada, escamas de la cúpula con puberulencia amarillo-rojiza, nuez hemisférica a ovoide, incluida un tercio a un medio en la cúpula.

Distribución.—Se conoce del sureste de Coahuila (Sierra de Arteaga) y en Nuevo León (en los municipios de Santiago, Galeana y Rayones). En Coahuila se le encuentra en localidades de la Sierra Madre Oriental como La Siberia, Las Vigas, El Coahuilón, La Marta, San José de los Nuncios y en las proximidades de Los Lirios. Es común en bosque de pino-encino y oyamel, así como en los límites de la vegetación alpina-subalpina. Se asocia principalmente con *Quercus greggii*, *Q. fulva*, *Q. saltillensis*, *Pinus pseudostrobus*, *P. greggii*, *Pseudotsuga menziesii*, *Abies vejarii*, *Populus tremuloides*, *Garrya ovata*, *Ceanothus buxifolius*, *Arbutus xalapensis*, *Salix lasiolepis* y *Prunus serotina*. Crece entre los 2400–3400 m de altitud, en laderas medias y altas con exposición norte y noroeste, donde forma poblaciones arbustivas densas, en las exposiciones sur y sureste es escaso. Se presenta como arbusto rizomatoso de 2–3 m de alto en cimas montañosas, laderas altas y cañones húmedos. Especie frecuente en las áreas donde habita, es considerada endémica para el área de Megacoahuila (Villarreal y Encina 2005).

Notas.—Se puede reconocer por las hojas coriáceas, elípticas a obovadas, de menos de 6 cm de largo, ápice redondeado a obtuso, margen conduplicado con 4–8 pares de dientes con aristas cortas y envés con pelos glandulares y pelos fasciculados en las nervaduras. Escamas de la cúpula casi planas. Relacionado con *Quercus greggii*, *Q. coahuilensis* y *Q. hypoxantha*.

Material examinado: **Mpio. Arteaga:** sierra de Arteaga, La Siberia, 25°15'N y 100°29'W, 2,400 m, 7 sep 1995, *J.A. Encina y M.A. Carranza 176* (ANSM); sierra Las Vigas, cañón de Jamé, 25°26'N y 100°30'W, 2,450 m, 8 may 1995, *M.A. Carranza* y *J.A. Encina 140* (ANSM). **Mpio. Ramos Arizpe:** sierra San José de los Nuncios, 1,765 m, 19 jul 1991, *G.B. Hinton 21097* (ANSM, TEX).**Mpio. Saltillo:** sierra de Zapalinamé, cerro el Penitente, 25°21'N y 100°54'W. 2,710 m, 15 nov 2004, *J.A. Encina et al. 1381* (ANSM)

Quercus hypoleucoides A. Camus, Bull. Mus. Hist. Nat. Paris. Ser. 2(4):124. 1932. (**Fig. 13**).

Quercus confertifolia Torr., U.S. Mex. Bound. Surv. Rpt. 207. 1840.
Quercus hypoleuca Engelm., Trans Acad. Sci. St. Louis 3:384. 1876.

Árbol de 10 a 20 m de alto; corteza dura, hendida y negra; ramillas rojas, de 2–3 mm de grosor, lenticelas poco evidentes, con indumento gris, glabrescentes; yemas ovoides, de 3 mm de largo y de 2 mm de ancho, café rojizas; estípulas caedizas. Hojas persistentes, gruesas y coriáceas; pecíolos de 5–7(–15) mm de largo, pubescentes, glabrescentes; limbos lanceolados, de 5–8(–11) cm de largo, de 1.5–3.0 cm de ancho, ápice agudo, terminando en arista, base redondeada a cuneada, margen fuertemente revoluto, entero o con pocos dientes terminados en aristas, haz verde oscuro o glauco, glabro o puberulento; envés con indumento blanquecino o canescente denso, de pelos fasciculados sesiles o cortamente estipitados; nervaduras 10–12 en cada lado, con algunas intermedias que se desvanecen, ramificadas y no evidentemente anastomosadas cerca del margen, algo impresas en el haz, salientes y nervadura media glabra en el envés. Inflorescencias masculinas de 3–6 cm de largo, blanco pilosas. Inflorescencias femeninas de 5–10 mm de largo, 1–2 flores en la parte terminal, pedúnculo con pelos fasciculados. Fruto anual o algunas veces bianual, solitario o en pares, sobre pedúnculos de hasta 15 mm de largo; cúpula hemisférica, de 8–12 mm de diámetro y 7–10 mm de alto, con escamas obtusas delgadas y apresadas, tomentulosas a glabras, café pálido; nuez oblonga a ovoide de 12–14 mm de largo y de 7–9 mm de ancho, puberulenta, glabrescentes, incluida cerca de un tercio en la cúpula.

Distribución.—Se distribuye desde Arizona y Nuevo México, oeste de Texas hasta la Sierra Madre Occidental en Sonora y Chihuahua. En Coahuila solo se encuentra en la región de la sierra del Carmen en el bosque de encino y bosque de pino-encino. Se asocia con *Quercus gravesii*, *Q. laceyi*, *Q. arizonica*, *Q. muehlenbergii*, *Q. arizonica*, *Q. rugosa*, *Pinus strobiformis*, *P. remota*, *Pseudotsuga menziesii*, *Cupressus arizonica*, *Prunus serotina*, *Juniperus deppeana*, *J. flaccida*, *Garrya ovata*, *Arbutus xalapensis*, *Salvia regla*, *Acer grandidentatum* y *Tilia mexicana*. Crece en elevaciones de 1700–2500 m sobre laderas altas y cañones, con exposiciones norte o noroeste, en cañones húmedos a través de arroyos (cañón del Centinela en la sierra del Carmen), como árbol de hasta 20 m de alto. Especie considerada rara en el área de Coahuila.

Notas.—Se reconoce por las hojas gruesas, lanceoladas, de 5–10 cm de largo, con apice agudo y aristado, margen entero o con pocos dientes aristados, haz verde y envés canescente, con indumento denso de pelos fasciculados, venación prominente. Escamas de la cúpula planas. Relacionado con *Quercus sideroxyla*,

Material examinado: **Mpio. Acuña:** roadside on Maderas del Carmen, 2,300 m, 13 jul 1997, *S. Wood, G. Harper* y *D. Doan-Crider s.n.* (ANSM), **Mpio. Ocampo:** sierra del Carmen, 1950 m, 17 sep 1989, *A.E. Estrada 1817* (ANSM); sierra del Carmen, 28°58'N y 102°33'W, 2,200 m, 12 ago 1975, *M.P. Robert* y *J. Passini 6583* (ANSM); El Jardín, exposición N de la sierra del Carmen, 2,200 m, 8 jun 1991, *J.A. Pérez 1766* (ANSM).

Quercus hypoxantha Trel., Mem. Natl. Acad. Sci. 20:170, pl. 339. 1924. (**Fig. 14**). TIPO: MÉXICO. COAHUILA: mountains near Saltillo, *C. G. Pringle 10227* (HOLOTIPO: GH).

Quercus errans Trel. f. *graciliramis* C.H. Mull., J. Arnold Arbor. 17:169. 1936)

Arbusto de hasta 2 m de alto, corteza gris obscura, lisa; ramillas de 0.5–1 mm de grosor, con puberulencia café-amarillenta, densa y persistente; yemas ovoides, cerca de 3 mm de largo, glabras, amarillo-rojizo; estípulas de 2 mm de largo. Hojas subpersistentes; pecíolos de 3–6 mm de largo, glabros, rojizos; limbos obovados a orbiculares, de (3–)4–5.5 cm de largo y (1.5)-2.5–3.5 cm de ancho, ápice redondeado a obtuso, base fuertemente cordada, el limbo frecuentemente conduplicado, margen ondulado, revoluto, con 3–4(–6) dientes aristados irregulares en cada lado especialmente hacia el ápice de la hoja, dientes irregularmente orientados, con aristas de 1–2 mm largo, haz con tricomas fasciculados diminutos, esparcidos, envés con indumento de pelos fasciculados estipitados, glabrescente; nervaduras 4–5(–6) en cada lado, irregulares y desiguales, frecuentemente ramificadas cerca del margen. Inflorescencias masculinas 5–6 cm de largo. Inflorescencias femeninas 1 o raramente 2 flores sobre pedúnculos tomentosos de 1–4 mm de largo. Fruto bianual, solitario, sobre pedúnculos de 2–6 mm de largo; cúpula hemisférica, de 10–12 mm de ancho y 7–8 mm de alto, escamas de la cúpula delgadas y poco apresadas, ápice redondeado, café claro, puberulentas; nuez ovoide, de 14–18 mm de largo y 10 mm de ancho, café claro, con puberulencia esparcida.

Distribución.—Se distribuye en la Sierra Madre Oriental, desde San Luis Potosí, hasta Nuevo León. En Coahuila solo se encuentra en el sureste del estado en las sierras de Arteaga y Zapalinamé. Crece en el matorral submontano, así como en los límites con el bosque de pino y oyamel, asociándose con *Quercus greggii*, *Q. striatula*, *Purshia plicata*, *Garrya ovata*, *Arctostaphylos pungens*, *Pinus arizonica* var. *stormiae*, *Rhus virens* y *Cercocarpus fothergilloides*. En bosques de oyamel se asocia con *Pseudotsuga menziesii*, *Cupressus arizonica* y *Abies vejarii*. Se localiza desde los 1900–2850 m de altitud, en laderas con exposiciones norte, noroeste o noreste, generalmente sobre terrenos con roca madre expuesta, donde forma matorrales. Es común en la localidad del Penitente en la sierra de Zapalinamé. Especie considerada como rara para el estado.

Notas.—Se puede reconocer por las hojas coriáceas, obovadas a orbiculares, usualmente de menos de 5 cm de largo, ápice redondeado a obtuso, margen conduplicado con 4–6 pares de dientes con aristas cortas y envés con indumento denso de pelos fasciculados. Escamas de la cúpula planas. Relacionado con *Quercus greggii*, *Q. coahuilenses* y *Q. hintoniorum*.

Material examinado: **Mpio. Arteaga:** predio Santa Anita, sierra Rancho Nuevo, al N de San Juan de Dolores, 25°26'N y 100°34'W, 2,800 m, 27 ago 2005, *J.A. Encina et al. 1410* (ANSM). **Mpio. Saltillo:** sierra de Zapalinamé, cañón de San Lorenzo, 25°23'N y 101°00'W, 1980–2060 m, 3 ago 1995, *M.A. Carranza* 2222 (ANSM); sierra de Zapalinamé, El Penitente, exposición NW, 25°21'N y 100°54'W, 2,710 m, 15 nov 2004, *J.A. Encina et al. 1267, 1382, 1395* (ANSM).

Quercus intricata Trel., Contr. U.S. Natl. Herb. 13:185. 1922. (**Fig. 15**). TIPO: MÉXICO. COAHUILA: Buenavista, *J, Gregg 256* (HOLOTIPO: US; ISOTIPO: GH).

Quercus microphylla Nee var. *crispata* A. DC., Prodr. 16(2):36. 1864.

Arbusto de 0.5–3 m de alto, gregario, intrincadamente ramificado; ramillas de 1–1.5 mm de grosor, con tomento corto, grisáceo-amarillento; yemas esféricas, de 1–1.5 mm de largo, café-rojizo; estípulas persistentes, subuladas, de cerca de 2 mm de largo, pubescentes. Hojas persistentes, gruesas y duras; pecíolos de 2–4 mm de largo, tomentosos; limbos ovados a usualmente oblongos o elíptico-oblongos, de 1–2(–5) cm largo y 0.5–1.5 cm de ancho, ápice obtuso, base cordada o cuneada, margen fuertemente revoluto y a menudo crispado, entero o con pocos dientes, haz lustroso, con pelos fasciculados esparcidos; envés con indumento denso y persistente, amarillo cremoso, de pelos fasciculados estipitados, glabrescente; nervaduras 6–9 en cada lado, impresas en el haz, salientes en el envés. Inflorescencias masculinas de 2–3 cm de largo, con raquis tomentoso y flores muy esparcidas. Inflorescencias femeninas de 3–10 mm de largo, 1–5 flores con el pedúnculo tomentoso. Fruto anual, solitario o en pares, subsésil o en pedúnculos tomentosos de hasta 1.5 cm de largo, cúpula cerca de 1 cm de diámetro y 7–8 mm de alto, escamas ovadas, canescentes y engrosadas en la base, con el ápice delgado y rojizo, apresado; nuez ovoide, de 9–12 mm de largo y 8–10 mm de ancho, casi glabra, color café claro, incluida de un medio a un tercio en la cúpula.

Distribución.—Con distribución desde el oeste de Texas, noreste de Chihuahua, hasta el centro-sur de Nuevo León, Zacatecas y noroeste de Durango. En Coahuila se distribuye en el noroeste, centro y sur, en casi todas las sierras. Es parte importante en el matorral submontano y en la transición con el matorral rosetófilo y bosque de pino piñonero. Se asocia con *Pinus cembroides*, *P. remota*, *Vauquelinia corymbosa*, *Quercus striatula*, *Q. invaginata*, *Q. pungens* var. *vaseyana*, *Q. mohriana*, *Q. pringlei*, *Q. coahuilensis*, *Cercocarpus montanus*, *Juniperus flaccida*, *Eysenhardtia texana*, *Arctostaphylos pungens*, *Dasylirion cedrosanum*, *Rhus virens*, *Ptelea trifoliata*, *Lindleya mespiloides*, *Amelanchier denticulata*, *Fraxinus greggii*, *Calia secundiflora* y *Mimosa texana*. Se desarrolla en elevaciones moderadas, apareciendo desde los 1600 hasta 2700 m de altitud, sobre laderas bajas con exposición norte, noreste, este y suroeste sobre terrenos pedregosos. Abunda en los márgenes de arroyos en el matorral submontano y en el estrato arbustivo en bosques abiertos de pino piñonero. Especie común en toda el área. Es conocido localmente como encino chaparro o charrasquillo.

Notas.—Se reconoce fácilmente por ser un arbusto con hojas gruesas, oblongas a elípticas, usualmente de 1–3 cm de largo, margen revoluto, entero o con dientes, haz verde amarillento y envés blanco-cremoso con indumento de pelos fasciculados, venación evidente. Escamas de la cúpula con base engrosada.

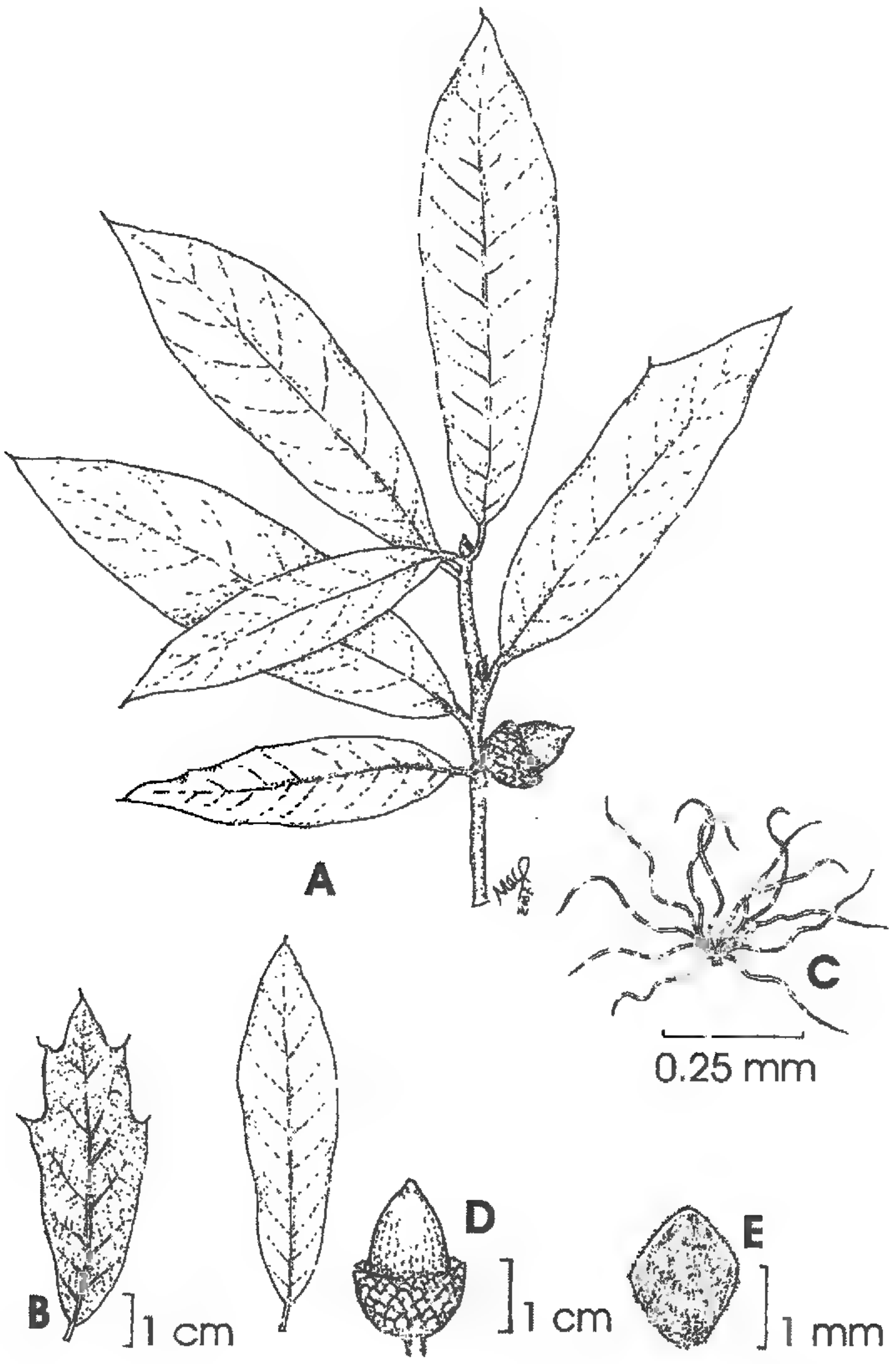
A
C
0.25 mm
B
1 cm
D
1 cm
E
1 mm

Fig. 13. *Quercus hypoleucoides*. A, rama con hojas y bellota; B, variación en hoja; C, pelo fasciculado; D, bellota; E, escama de la cúpula.

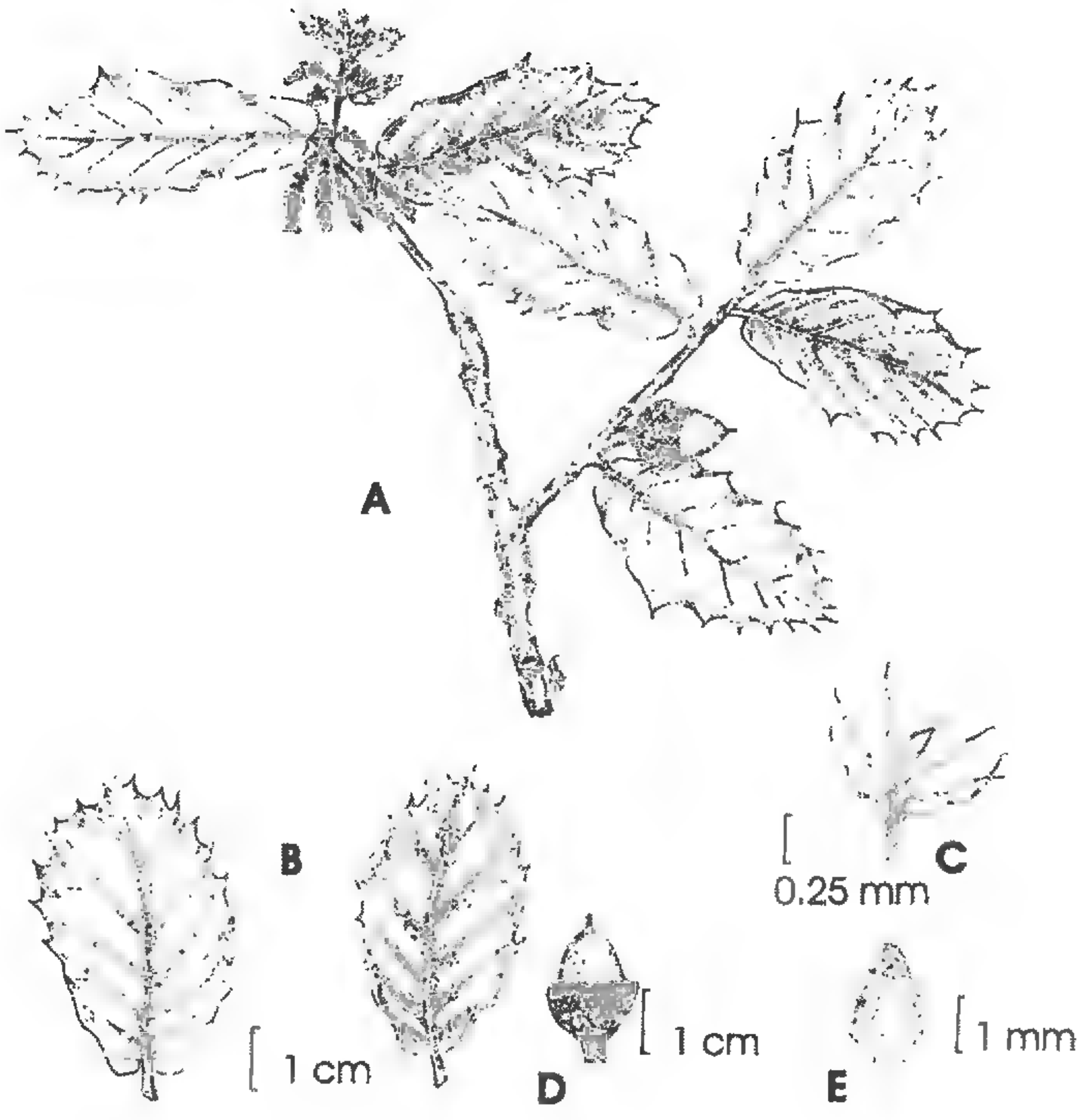
A
B
C
0.25 mm
1 cm
1 cm
D
E
1 mm

Fig. 14. *Quercus hypoxantha*. A, rama con hojas, amentos y bellota; B, variación en hoja; C, pelo fasciculado estipitado; D, bellota; E, escama de la cúpula.

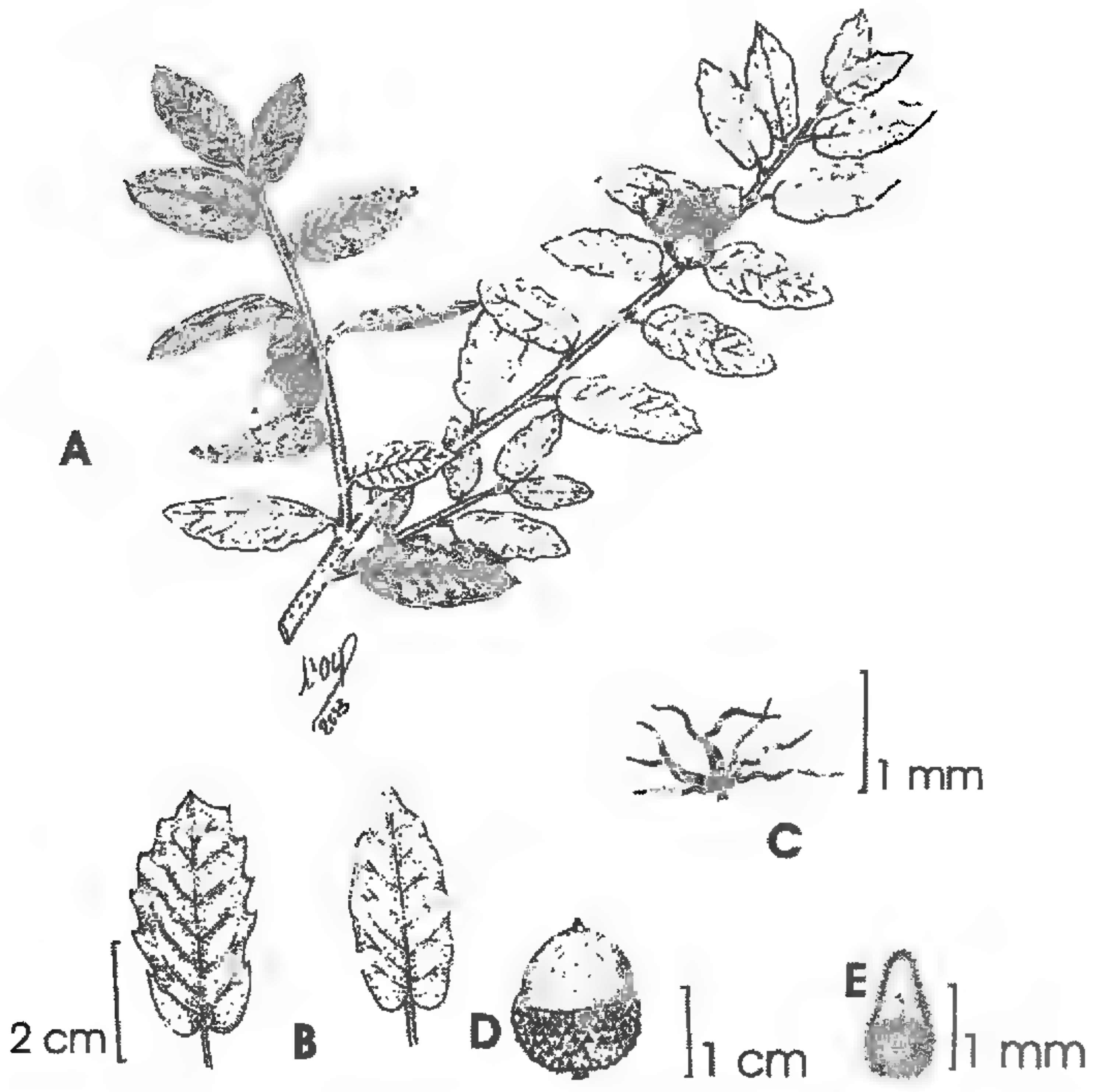
A
1 mm
C
2 cm
B
D
1 cm
E
1 mm

Fig. 15. *Quercus intricada*. A, rama con hojas y bellotas; B, variación en hojas; C, pelo fasciculado; D. bellota; E, escama de la cúpula.

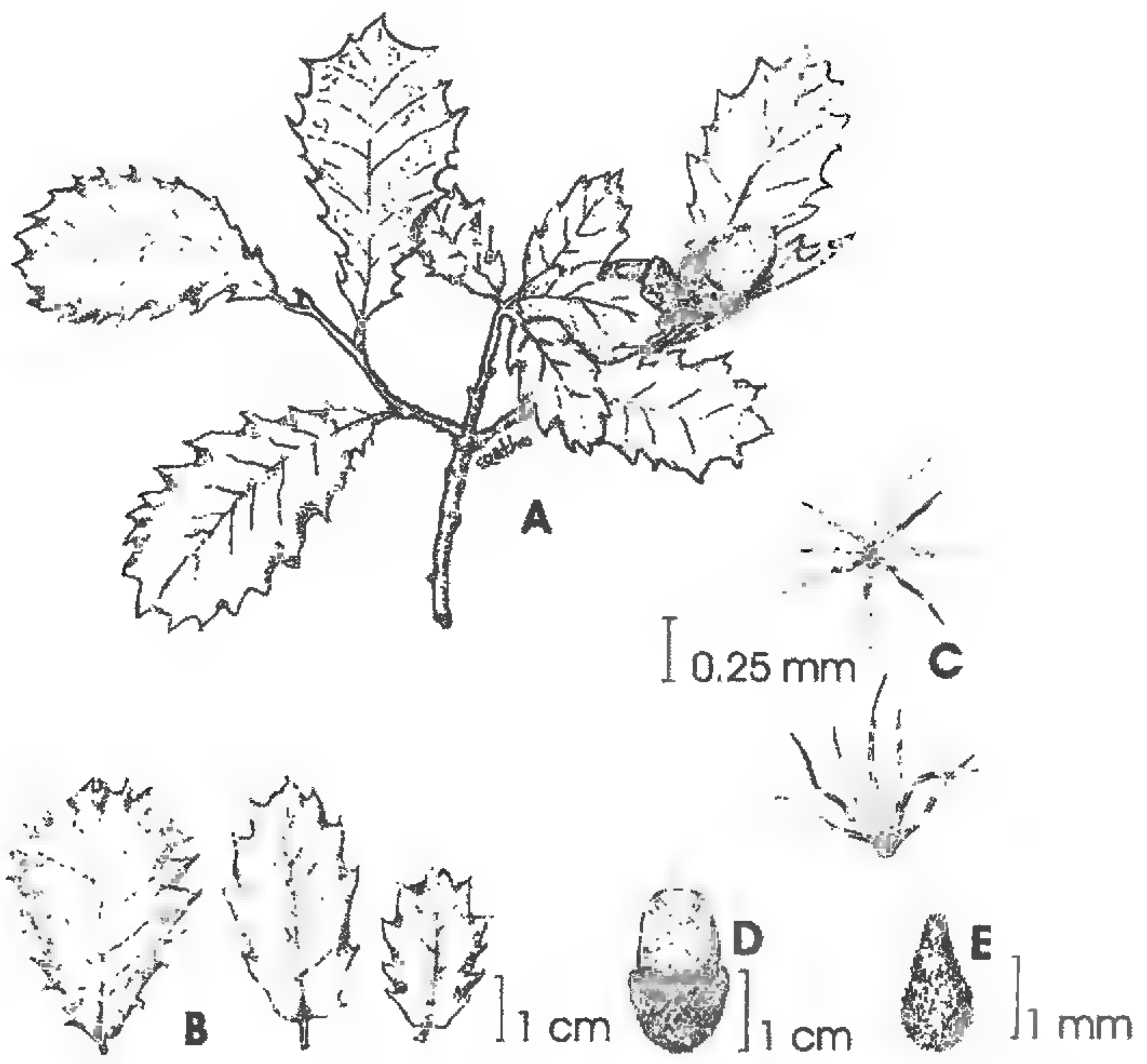
A
0.25 mm
C
B
1 cm
D
1 cm
E
1 mm

Fig. 16. *Quercus invaginata*. A, rama con hojas y bellotas; B, variación en hojas; C, pelo fasciculado; D, bellota; E, escama de la cúpula.

Material examinado: **Mpio. Acuña:** sierra del Carmen, cañón del Diablo, 29°11'N y 102°47'W, 10 ago 1974, *T. Wendt 551* (ANSM, TEX). **Mpio. Arteaga:** sierra de Arteaga, entronque carretera Los Lirios, 25°25'N y 101°47'W, 1,800 m, 2 nov 1996, *J.A. Encina et al. 121* (ANSM). **Mpio. Castaños:** sierra La Gavia, rancho La Gavia, 26°10'N y 101°18'W, 1,500 m, 10 ag0 1995, *M.A. Carranza* y *J.A. Encina 173* (ANSM). **Mpio. Cuatro Cienegas:** sierra de La Madera, cañón del Invierno, 27°04'N y 102°28'W, 2,725 m, 28 ago 1974, *T. Wendt* y *E. Lott 636* (ANSM, TEX); sierra San Marcos, ejido de Norias, cañón Grande, 26°30'N y 101°40'W, 2,500 m, 19 oct 1993, *M.A. Carranza et al. 1852* (ANSM). **Mpio. General Cepeda:** sierra La Paila, valle de Parreños, 25°28'N y 101°25'W, 1,600 m, 12 sep 1989, *J.A. Villarreal* y *M.A. Carranza 464* (ANSM); sierra L a Concordia, ejido El Tejocote, 25°14'N y 101°37'W, 2,130 m, 13 jul 2002, *J.A. Encina et al. 1251* (ANSM). **Mpio. Ocampo:** rancho La Cruz, 27°15'N y 102°40'W, 1,800 m, 11 sep 1991, *M.A. Carranza* y *L. García 1189* (ANSM); sierra El Pino, ejido Acebuches, cañón La Vaca, 28°15'N y 102°59'W, 1,850 m, 2 oct 2004, *M.A. Carranza* e *I. Ramirez 4017* (ANSM). **Mpio Parras:** ejido Tanque Nuevo, 25°15'N y 101°44'W, 1,950 m, 11 jul 2002, *J.A. Encina et al. 1244* (ANSM). **Mpio. Ramos Arizpe:** sierra San José de los Nuncios, 1,630 m, 19 jul 1991, *G.B. Hinton 21075* (ANSM); sierra La Paila, cañón Loma Prieta, 25°51'N y 101°30'W. 1,600 m, 23 oct 1985, *J.A. Villarreal et al. 3118* (ANSM). **Mpio. Saltillo:** sierra La Concordia, Carneros, 18 nov 1974, *J. Marroquín 3048* (ANSM), sierra del Duraznillo, ejido Tinajuela, 25°04'N y 101°17'W, 14 ago 2004, *J.A. Encina et al. 1348* (ANSM), sierra La Concordia, ejido San Blas, cañón Troncones, 23°17'N y 101°18'W, 2 oct 1994, *M.A. Carranza et al. 3157* (ANSM).

Quercus invaginata Trel., Mem. Natl. Acad. Sci. 20:87, pls. 137, 138. 1924. (**Fig. 16**). Tipo: MÉXICO. Ramos Arizpe, sierra La Paila, *C. A. Purpus 5029* (holotipo: B; isotipos: GH, MO).

Quercus invaginata Trel. f. *purpusiana* Trel., Mem.Natl. Acad. Sci. 20:87, pl. 138. 1924. Tipo: MÉXICO: Ramos Arizpe, sierra La Paila, *C. G. Purpus 5030* (holotipo: B; isotipo: NY))

Arbusto o árbol de 1–3(–9) m de alto, con corteza gris escamosa o surcada; ramillas con indumento blanquecino, denso y persistente; yemas ovoides, de 1–3 mm de largo, café rojizo; estípulas setáceas y deciduas de 2–3 mm de largo. Hojas coriáceas deciduas; pecíolos de (3–)5–8 mm de largo, gris tomentoso; limbos obovados a oblongos o elípticos, de (2–)3–5(–6) cm de largo y (1–)2–3.5 cm de ancho, ápice redondeado a subagudo u obtuso, base cuneada a obtusa o redondeada, rara vez subcordada, margen ondulado, crispado, con dientes toscos mucronados o raramente subentero; haz verde claro y opaco, con pelos fasciculados esparcidos, envés con indumento denso blanco-grisáceo de pelos fasciculados; nervaduras 6–10 en cada lado, anastomosadas y terminando en un mucrón, poco impresas en el haz, muy prominentes en el envés. Inflorescencias masculinas de 2–3 cm de largo. Inflorescencias femeninas de 5–10 mm de largo, con 1–3 flores en pedúnculos pubescentes, hasta de 3 mm de largo. Fruto anual, solitario o en grupos de 2–3, subsésil o sobre un pedúnculo de 5–10(–17) mm de largo, cúpula turbinada, de 10–20 mm de diámetro, al madurar con los márgenes marcadamente involutos, escamas agudas con tomento grisaceo, base algo engrosada; nuez elíptica a oblonga, de 10–15 mm de largo, café claro, glabra excepto en la parte apical, incluida cerca de un tercio en la cúpula.

Distribución.—Se distribuye en el centro y noroeste de Coahuila, en las sierras de La Paila, La Gavia, La Madera y del Pino, y en el centro-norte de Nuevo León, como un componente importante en matorral submontano, en la ecotonía con el matorral rosetófilo, así como en bosques de pino-encino y de encino. Se asocia con elementos de *Pinus remota*, *P. arizonica* var. *stormiae*, *Quercus pringlei*, *Q. gravesii*, *Q. intricata*, *Q. laceyi*, *Q. coahuilensis*, *Fraxinus greggii*, *Ungnadia speciosa*, *Vauquelinia corymbosa*, *Pistacia texana*, *Juniperus flaccida*, *Dasylirion cedrosanum*, *Calia secundiflora*, *Gochnatia hypoleuca*, *Ptelea trifoliata*, *Cercocarpus montanus*, *Acacia berlandieri* y *Colubrina greggii*. Crece en altitudes de 1600–2200 m, presentándose disperso desde los 1250 m, sobre laderas bajas con exposiciones norte, noroeste y en fondo de cañones, forma poblaciones arbustivas densas en el matorral submontano, es frecuente en los bosques de encino y de pino-encino. En el matorral rosetófilo se presenta en forma esparcida. Abunda en las sierras del centro del estado y disminuye con el aumento de la altitud y la latitud. Marroquín (1985) la reporta para el noroeste de Nuevo Léon, frecuente en el cauce de los arroyos, sobre laderas de exposición oeste entre los 600–1700 m de altitud. Especie considerada como endémica para el área de Coahuila y común en los lugares donde habita.

Notas.—Se reconoce por las hojas coriáceas, obovadas, oblongas a elípticas, usualmente de menos de 5 cm de largo, ápice redondeado a obtuso, margenes ondulados a crispados, dentado-mucronados, haz verde, glabro y envés con indumento de pelos fasciculados. Cracterísticamente la cúpula presenta el margen involuto y las escamas con la base ligeramente engrosada. En algunos casos pueden presentarse semejanzas foliares con *Q. grisea*.

Material examinado: **Mpio. Candela:** sierra Pájaros Azules, campo Santa María, cañada La Sabanilla, 27°02'N y 100°54'W, 5 dic 1997, *M.A. Carranza* y *D. Sánchez 2882* (ANSM). **Mpio. Castaños:** sierra La Gavia, cañón La Gavia, 26°20'N y 101°15'W, 10 sep 1987, *J.A. Villarreal* y *M.A. Carranza 4037* (ANSM), sierra La Gloria, cañón Chilpitín, 26°48'N y 101°17'W, 7 sep 1976. *T. Wendt* y *D. Riskind 1684* (ANSM, TEX). **Mpio. Cuarto Cienegas:** sierra de San Marcos, cañón Grande, ejido Estanque de Norias, 27°40'N y 102°50'W, 1 oct 1993, *M.A. Carranza et al. 104* (ANSM), sierra La Madera, mouth of cañada Los Posos, 27°07'N y 102°27'W, 26 jul 1977, *T. Wendt* y *J. Valdés 1052* (ANSM). **Mpio. Monclova:** sierra La Gloria, cañada La Tienda, 26°56'N y 101°25'W, 11 ago 1995, *M.A. Carranza* y *J.A. Encina 2376* (ANSM). **Mpio. Ocampo:** sierra La Encantada, cuesta Malena, 28°54'N y 102°30'W, 29 mar 1992, *M.A. Carranza et al. 1514* (ANSM). **Mpio. Ramos Arizpe:** sierra La Paila, cañón El Diente, 26°09'N y 101°30'W, 5 oct 1988, *J.A. Villarreal* y *M.A. Carranza 4666* (ANSM).

Quercus laceyi Small, Bull. Torrey Bot. Club 28:358. 1901. (**Fig. 17**). Tipo: E.U.A. Texas. Kerr Co.: Lacey's ranch near Kerrville, *H. Lacey s.n.* (holotipo: NY).

Quercus breviloba Sarg. f. *laceyi* (Small) Trel., Mem. Nat. Acad. Sci. 20:102. 1924. *Quercus breviloba* Sarg. ssp. *laceyi* (Small) A. Camus, Chenes 2:280. 1939.

Arbusto o árbol de 5–8(–10) m de alto; corteza gruesa, fisurada y gris; ramillas de 1–3 mm de grosor, acanaladas, pubescentes, pronto glabrescentes, café rojizo; yemas ovoides a cónicas de 2–6 mm de largo, con indumento esparcido; estípulas deciduas, subuladas, de 5 mm de largo. Hojas delgadas, deciduas, glaucas; pecíolos de 3–10 mm de largo, delgados, glabros o con indumento esparcido; limbos oblongos, elípticos a obovados, de 3–7(–10) cm de largo y 2.5–4(–6) cm de ancho, ápice redondeado u obtuso, base redondeada o cuneada, rara vez cordada, margen cartilaginoso, irregularmente sinuado o con pocos lóbulos en cada lado, raramente dentado o entero; haz glabro, o con pelos fasciculados escasos, verde azulado, grisáceo, ligeramente brillante, envés con pelos fasciculados escasos, glabrescente, verde amarillento o glauco; nervaduras 7–9 en cada lado, irregulares, ramificadas y anastomosadas, poco salientes en ambas superficies. Inflorescencias masculinas de 3–6 cm de largo. Inflorescencias femeninas de 5 mm de largo, con 1–3 flores. Fruto anual, solitario o en pares, subsésil o sobre pedúnculos de 1 cm de largo, cúpula de 15–18 mm de ancho, de 4–7 mm de alto, escamas de la cúpula ovadas, base engrosada, con poco tomento y ápice delgado poco apresado, glabro, café rojizo; nuez cónica, ovoide o subcilíndrica de 1.5–2(–3) cm de largo y 9–14 mm de ancho, glabra excepto cerca del ápice, café claro, incluida menos de la mitad en la cúpula.

Distribución.—Se distribuye en el centro (Planicies Edwards) y oeste (Trans-Pecos) de Texas, en México a través de la Sierra Madre Oriental en Coahuila, Nuevo León y probablemente en Tamaulipas. En Coahuila se encuentra ampliamente distribuido en la sierras del noroeste y centro, desde la sierra del Carmen, serranias del Burro, del Pino, de San Marcos hasta la sierra La Paila. En las sierras de Zapalinamé y La Concordia, se encuentran poblaciones aisladas. Es una especie propia del bosque de pino-encino, así como del bosque de encino, asociándose con especies de *Quercus gravesii*, *Q. invaginata*, *Q. mohriana*, *Q. grisea*, *Q. muehlenbergii*, *Q. emoryi*, *Q. hypoleucoides*, *Rhus virens*, *Juniperus flaccida*, *Pinus arizonica* var. *stormiae*, *P. remota*, *Arbutus xalapensis*, *Cercis canadensis*, *Prunus serotina*, *Tilia mexicana*, *Dodonaea viscosa*, *Acer grandidentatum*, *Ungnadia speciosa*, *Fraxinus berlanderiana*, *Pistacia texana*, *Diospyros texana* y *Juglans microcarpa*. Crece en altitudes entre 1000–2500 m, sobre laderas con exposición norte, noroeste u oeste y en fondo de cañones. Se presenta como arbolito en laderas pedregosas con suelos someros, mientras que en cañones protegidos con humedad y a orillas de arroyos es un árbol. Es abundante en las sierras del centro-norte del estado, raro en las sierras del sur del estado. Especie común en el área donde habita.

Notas.—Se reconoce por las hojas delgadas, glabras, verde azulosas, oblongas a obovadas, de hasta 10 cm de largo, ápice obtuso a redondeado, margen sinuado o con lóbulos cortos y redondeados, nervación no resaltada. Escamas de la cúpula con base engrosada.

Quercus laceyi ha sido reconocido y separado de *Q. glaucoides*, con el cual se ha confundido en algunos tratamientos florísticos. Esta última especie se ha encontrado que restringe su distribución al centro y sur de México (Nixon y Muller 1992).

Material examinado: **Mpio. Acuña:** serranias del Burro, rancho El Bonito, 29°01'N y 102°07'W, 1,625 m, 19 sep 1977, *D. Riskind* y *C.H. Muller 2200* (ANSM, TEX). **Mpio. Candela:** sierra de Pajaros Azules, campo Santa María, 27°01'N y 100°50'W, 1,800 m, 4 jun 1997, *P. Cruz 10* (ANSM). **Mpio. Castaños:** sierra La Gavia, rancho La Gavia, 26°10'N y 101°18'W, 1,295 m, 10 ago 1995, *M.A. Carranza* y *J.A. Encina 171* (ANSM). **Mpio. Cuatro Cienegas:** sierra San Marcos, ejido Estanque de Norias, cañón Grande, 27°40'N y 102°50'W, 1,550 m, 1 oct 1993, *M.A. Carranza et al. 105* (ANSM); sierra La Madera, cañón La Hacienda, 27°05'N y 102°25'W, 1,600 m, 11 may 1973 (ANSM, TEX). **Mpio. General Cepeda:** sierra La Concordia (sierra El Rancho), arroyo El Mimbre, ejido El Tejocote, 25°16'N y 101° 37'W, 1,900 m, 6 jun 1995, *M.A. Carranza* y *J.A. Encina 2194* (ANSM). **Mpio. Monclova** (limites con Castaños), sierra La Gloria, cañón El Cono, 26°49'N y 101°17'W, 1,220 m, 6 sep 1976, *T. Wendt* y *D. Riskind 1628* (ANSM, TEX). **Mpio. Muzquiz:** sierra Santa Rosa, rancho El Silencio, 27°55'N y 101°50'W, 1,300 m, 2 may 2004, *S. Lara* y *R. Pineda 100* (ANSM); sierra Santa Rosa (La Babia), rancho La Babia, cañón Rincón de María, 28°27'N y 102°04'W, 1,450 m, 17 sep 1999, *J.A. Villarreal et al. 8767* (ANSM). **Mpio. Ocampo:** sierra del Pino, ejido Acebuches, cañón La Vaca, 28°15'N y 102°59'W, 1,850 m, 30 sep 2003, *M.A. Carranza* e *I. Ramirez 3982* (ANSM); sierra Madreas del Carrmen, canyon La Fronteriza, from where it joins the cañón del Alamo, about 0.8 mi N of rancho San Isidro, 28° 54'N y 102° 32'W, 1510 m, 12 aug 2004, *D. Riskind, J Valdés* y *J. Henrickson 23858, 23865* (ANSM, TEX). **Mpio. Ramos Arizpe:** sierra La Paila, camino a El Cedral, 25°59'N 101°28'W. 1,250 m, 8 oct 2005, *J. A Villarreal* e *I. Ramirez 9291* (ANSM). **Mpio. Saltillo:** sierra de Zapalinamé, cañón por el camino a El Cuatro, 25°21'N y 101°55'W. 2,100 m, 21 ago 2004, *J.A. Encina et al. 1352* (ANSM). **Mpio. Zaragoza:** serranias del Burro, rancho La Escondida, 28°56'N y 101°51'W, 1,200 m, 6 may 2003, *M. Guerrero* y *O. Ballesteros s.n.* (ANSM).

Quercus laeta Liebm., Overs. Kongel. Danske Vidensk. Selsk. Forh. Medlemmers Arbeider. 179. 1854. (**Fig. 18**). TIPO: MÉXICO. Hidalgo: Casa Grande, *Hartweg 419* (HOLOTIPO: B).

Quercus centralis Trel., Mem. Natl. Acad. Sci. 20:61. 1924.
Quercus prinopsis Trel., Mem. Natl. Acad. Sci. 20:61, pl. 58. 1924.
Quercus obscura Trel., Mem. Natl. Acad. Sci. 20:71. 1924.
Quercus transmontana Trel., Mem. Natl. Acad. Sci. 20:71, pl. 89. 1924.
Quercus pallescens Trel., Mem. Natl. Acad. Sci. 20:89, pl. 141. 1924.
Quercus bipedalis Trel., Mem. Natl. Acad. Sci. 20:89, pl. 143. 1924.
Quercus clivicola Trel. et C.H. Mull., Bull. Torrey Bot. Club 66:149. 1936.

Árbol de 5–8(–15) m de alto, raramente arbusto; corteza café rojiza o negra; ramillas de 1.5–3 mm de grosor, acanaladas, con indumento amarillo y pelos glandulares, lenticelas abundantes; yemas ovoides, de 2–3 mm de largo; estípulas membranosas, pilosas, de 4–6 mm de largo, caedizas. Hojas coriáceas, deciduas, verde amarillentas o rojizas; pecíolos de 2–5(–8) mm de largo, pubescentes; limbos elípticos a oblongos, lanceolados u obovados, de 5–9(–15) cm de largo y 2–3(–6.5) cm de ancho; ápice obtuso, redondeado o acuminado, base redondeada o cordada, margen engrosado y revoluto, entero o con 2–11 dientes mucronados; haz verde claro y lustroso, con pelos fasciculados diminutos y pelos glandulares simples; envés pálido con indumento amarillo de pelos fasciculados, cortamente estipitados y pelos glandulares rojizos a lo largo de la nervadura principal, epidermis ampulosa; nervaduras 7–12 en cada lado. Inflorescencias masculinas de 4–6 cm de largo, pilosas y con pelos glandulares. Inflorescencias femeninas de 1–3 flores. Fruto anual, solitario o en grupos hasta de tres, de 1–2(–4) cm de largo, cúpula hemisférica, de 12–15 mm de diámetro, escamas engrosadas y pubescentes en la base, ápice estrecho, obtuso y apresado, nuez ovoide de 10–18 mm de largo, incluida un medio o un tercio en la cúpula.

Distribución.—Se distribuye en la República Mexicana en los estados de Durango, Sinaloa, Zacatecas, Aguascalientes, Nayarit, Jalisco, Michoacán, Guanajuato, Hidalgo, Distrito Federal, Puebla, San Luis Potosí y Nuevo León. En Coahuila se le encuentra en el centro y sureste, en las sierras La Paila, La Concordia, Zapalinamé y de Arteaga, en bosques húmedos de encino y bosque de pino-encino. Se asocia con *Pinus arizonica* var. *stormiae*, *Juniperus flaccida*, *Quercus saltillensis*, *Q. laceyi*, *Cupressus arizonica*, *Arbutus xalapensis*, *Cercocarpus montanus*, *Garrya ovata* y *Crataegus baroussana*. Crece en altitudes de 1400–2900 m, sobre laderas bajas, con exposición norte, en cañones y valles intermontanos con suelos profundos o bien en los márgenes de arroyos, donde se presenta como un árbol, mientras en laderas con suelos someros es común encontrarlo como un arbusto o arbolito. Es frecuente en las sierras de Zapalinamé, La Concordia y de Arteaga, raro en la sierra La Paila. Especie común en los lugares donde habita.

Notas.—Se reconoce por las hojas coriáceas, verde amarillentas, elípticas a oblongas, de hasta 15 cm de largo, ápice obtuso, margen entero o con 2–11 pares de dientes, haz casi glabro y envés con indumento de pelos fasciculados, venación prominente. Escamas de la cúpula con base engrosada, prolongada hacia el ápice.

Material examinado: **Mpio. Arteaga:** sierra de Arteaga, Potero de Abrego, camino a Los Lirios, 25°20'N y 100°28'W, 2,300 m, 30 abr 1987, *J.A. Villarreal* y *M.A. Carranza 3631* (ANSM). **Mpio. General Cepeda:** sierra La Concordia, Pilote de Fierro, ejido La Casita, 25°10'N y 101°25'W, 2,950 m, 13 ago 1993, *J.A. Encina et al. 101* (ANSM). **Mpio. Ramos Arizpe:** sierra La Paila, ejido El Cedral, 26°02'N y

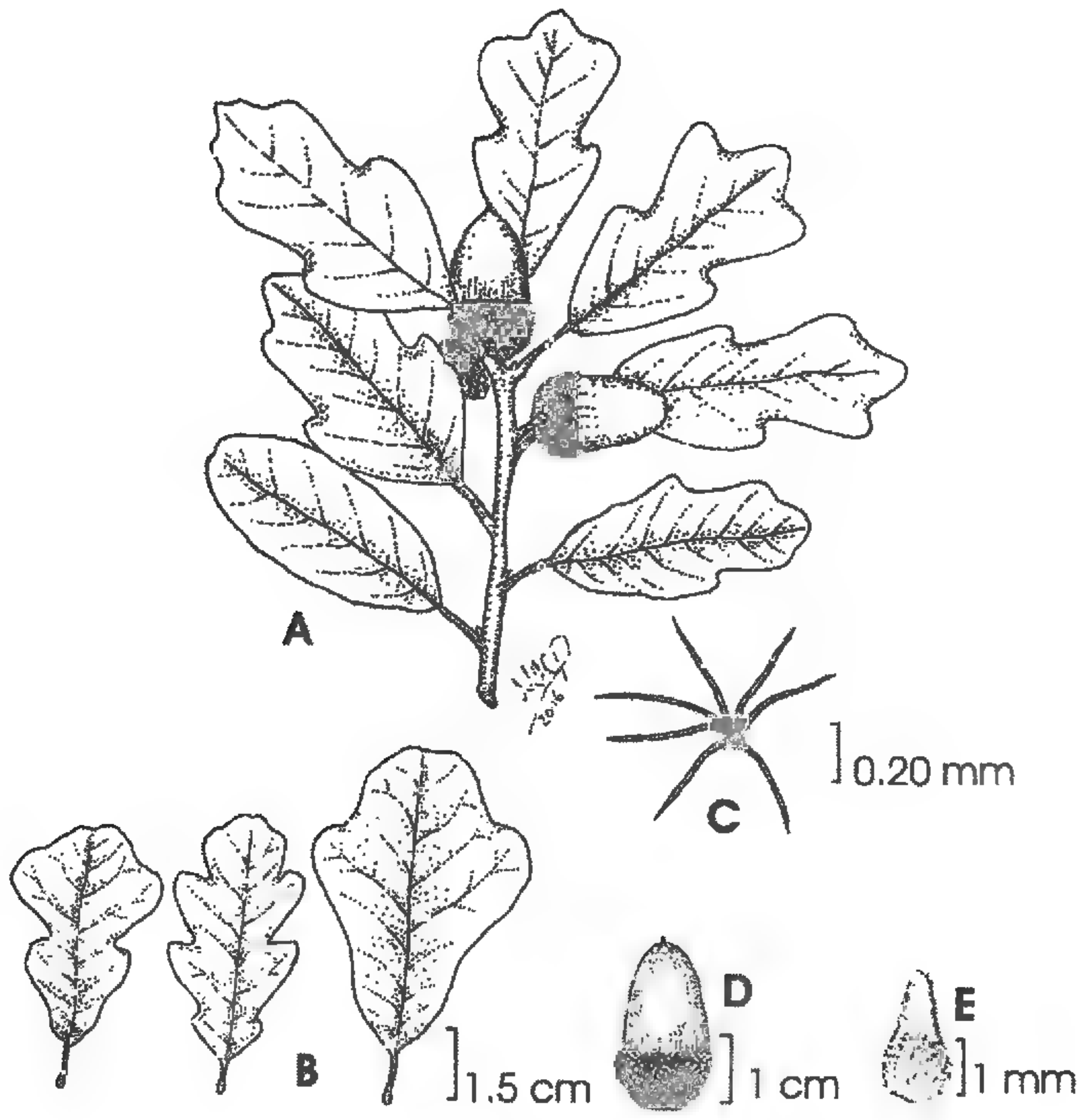
A
C
0.20 mm
B
1.5 cm
D
1 cm
E
1 mm

Fig. 17. *Quercus laceyi*. **A**, rama con hojas y bellotas; **B**, variación en hoja; **C**, pelo fasciculado; **D**, bellota; **E**, escama de la cúpula.

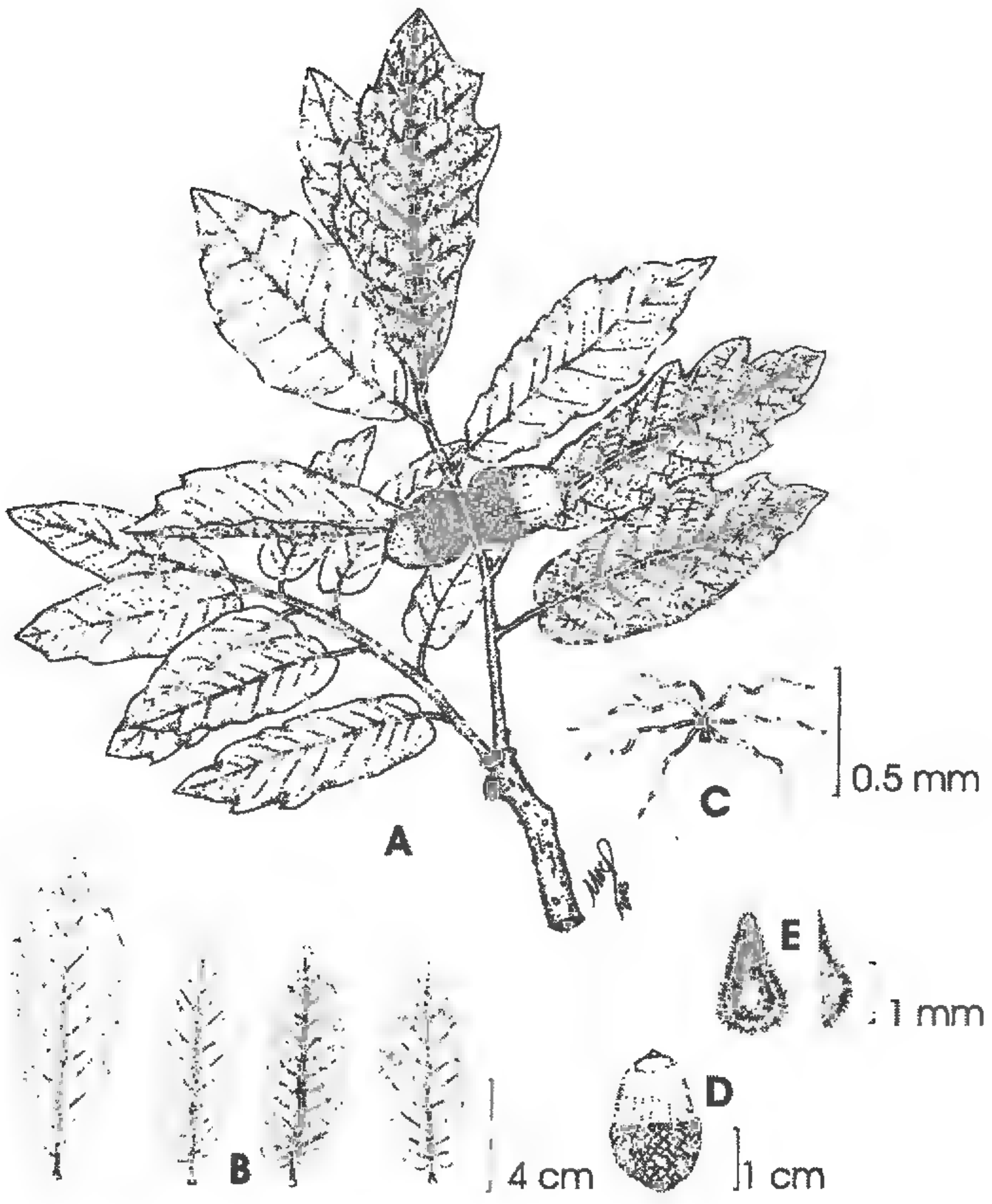
A
0.5 mm
C
E
1 mm
B
4 cm
D
1 cm

Fig. 18. *Quercus laeta*. **A**. rama con hojas y bellotas; **B**, variación en hoja; **C**, pelo fasciculado; **D**, bellota; **E**, escama de la cúpulA, vista frontal y lateral.

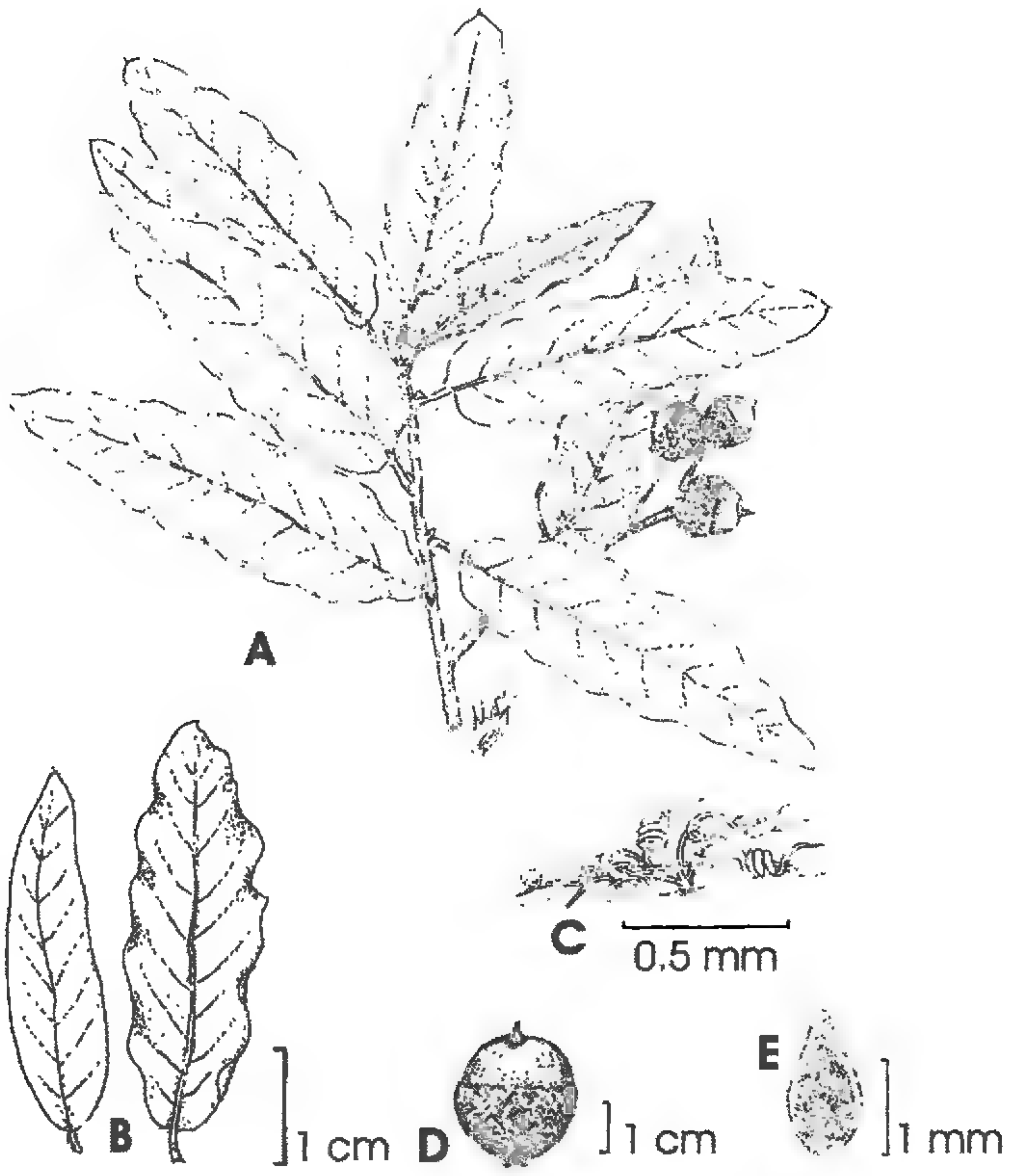
A
C
0.5 mm
B
1 cm
D
1 cm
E
1 mm

Fig. 19. *Quercus mexicana*. **A**, rama con hojas y bellotas; **B**, variación en hoja; **C**, pelo fasciculado con radios enredados; **D**, bellota; **E**, escama de la cúpula.

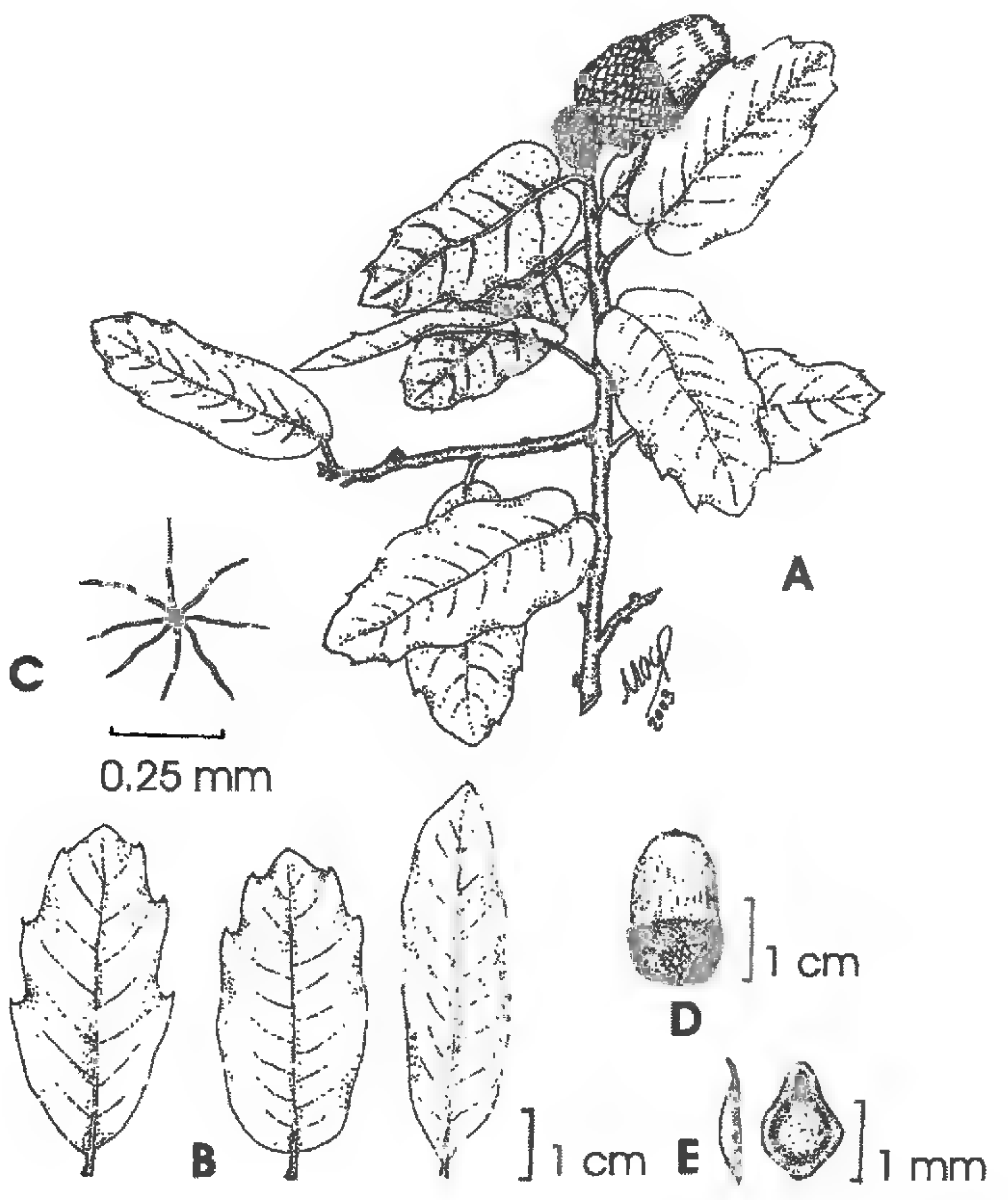
A
C
0.25 mm
1 cm
D
B
1 cm
E
1 mm

Fig. 20. *Quercus mohriana*. **A**, rama con hojas y bellota; **B**, variación en hoja; **C**, pelo fasciculado; **D**, bellota; **E**, escama de la cúpula, vista lateral y frontal.

101°23'W, 1,400 m, 2 nov 1988, *J.A. Villarreal* y *M.A. Carranza 4784* (ANSM). **Mpio. Saltillo:** sierra de Zapalinamé, cañón por el camino a El Cuatro, 25°21'N y 100°56'W, 2,100 m, 21 ago 2004, *J.A. Encina et al. 1350* (ANSM).

Quercus mexicana Humb. et Bonpl., Pl. Aequinoct. 2. 35, pl. 82. 1809. (**Fig. 19**). Tipo: MÉXICO. Guanajuato: Santa Rosa, *A. Bonpland 4218* (holotipo: B).

Quercus rugulosa M. Martens et Galeotti, Bull. Acad, Brux. 10:209. 1843.
Quercus pablillensis C.H. Mull., Amer. Midl. Naturalist 27:477. 1942.

Árbol de 3–8(–20) m de alto; ramillas café oscuro a grisáceo glabrescentes; yemas ovoides, de 2–3 mm de largo, café brillantes; estípulas caedizas, lineares, liguladas, de 4–5 mm de largo, densamente pubescentes. Hojas deciduas, algo rígidas; pecíolos de 3–6(–10) mm de largo, pubescentes; limbos ovados, elípticos u oblongos, de 3–6(–8) cm de largo y 1–2.5 cm de ancho, ápice agudo u obtuso, raras veces redondeado, terminando en una arista corta y quebradiza, base cordada a redondeada, margen entero, cartilaginoso, revoluto y algunas veces crispado; haz algo brillante y glabro, con indumento de pelos fasciculados a lo largo del nervio medio; envés con indumento denso de pelos fasciculados, con radios contortos, enredados, aislados, formando puntos amarillentos sobre la epidermis; nervaduras 7–10(–15) en cada lado, ramificadas y anastomosadas, prominentes en el envés, no evidentes en el haz. Inflorescencias masculinas de 3–5 cm de largo, raquis lanoso. Inflorescencias femeninas de 3–6 mm de largo, con 1–3 flores, pedúnculos de hasta 5 mm de largo, indumento escaso. Fruto bianual, solitario o en grupos de 2–3 sobre un pedúnculo de 1–5 mm largo; cúpula hemisférica, de 10–15 mm de ancho y 6–9 mm de alto, escamas delgadas, apresadas, glabras o puberulentas, ápice obtuso o redondeado, base un poco engrosada; nuez ovoide, de 12–15 mm de largo y 10 mm de diámetro, café claro, puberulentas, incluida de un tercio a un medio en la cúpula.

Distribución.—Se distribuye en el centro y sureste de México en los estados de San Luis Potosí, Querétaro, Hidalgo, Puebla, México y Chiapas, hacia el noreste a través de la Sierra Madre Oriental en Tamaulipas y Nuevo León. En Coahuila se encuentra solo en la sierra de Zapalinamé al sureste del estado, en bosques de encino y pino-encino. Se asocia con componentes de *Quercus saltillensis*, *Q. rugosa*, *Q. greggii*, *Fraxinus cuspidata*, *Cercis canadensis*, *Salix lasiolepis*, *Juniperus flaccida*, *Cupressus arizonica*, *Arbutus xalapensis*, *Prunus mexicana*, *Pinus cembroides* y *Bumelia lanuginosa.* Crece entre los 1900–2750 m de altitud. Abundante en el bosque de encino, en laderas bajas donde llega a formar un bosque denso. Común en el cañón de San Lorenzo, en la sierra de Zapalinamé. La especie es considerada como rara en Coahuila.

Notas.—Se puede reconocer por las hojas elípticas a oblongas de hasta 8 cm de largo con ápice agudo a obtuso, cotamente aristado, el margen entero, glabras. Es caracteristico el enves con venación prominente, con mechones de pelos en las axilas de la nervadura principal con las secundarias, con pelos fasciculados con radios contortos y algo enredados. Bellota casi esferica con escamas de la cúpula con base ligeramente engrosada.

Material examinado: **Mpio. Arteaga:** sierra La Atravesada, 25°14'N y 100°54'W, 2,480 m, 2 nov 2003, *E. Padilla 1167* (ANSM). **Mpio. Saltillo:** sierra de Zapalinamé, cañón de Santa Rosa, rumbo a los Aguajes, 25°19'N y 100°57'W, 2,427 m, 11 feb 2002, *J.A. Encina et al. 695, 721* (ANSM); sierra de Zapalinamé, cañón de San Lorenzo, 25°23'N y 101°00'W, 2,060 m, 3 ago 1995, *M.A. Carranza* y *J.A. Encina 162* (ANSM), *J.A. Encina* y *R. Cardenas 462* (ANSM).

Quercus mohriana Buckley, Bull. N.Y. Bot. Gard. 2:219. 1901. (**Fig. 20**). Tipo: E.U.A. Texas. Val Verde Co.: *S.B. Buckley s.n.* (lectotipo: TEX; isotipo: NY).

Arbusto rizomatoso o árbol de 0.5–5 m de alto; ramillas de 1–2 mm de grosor, con indumento grisaceo; yemas 1–2 mm de largo, ovoides o redondeadas, café rojizo oscuro, indumento escaso; estípulas caducas, subuladas a filiformes, de 3 mm de largo, pubescentes. Hojas persistentes o deciduas, coriáceas; pecíolos de 2–5 mm de largo, pubescentes; limbos oblongos a elípticos, de (1.5–)3–5(–8) cm de largo y (1.0–)2–3(–3.5) cm de ancho, ápice obtuso u algunas veces agudo, base redondeada a cuneada, margen poco revoluto, crispado o plano, entero u onduladamente dentado o denticulado, haz verde oscuro, lustroso, con pelos multirradiados diminutos, esparcidos, envés con indumento denso, grisáceo; nervaduras 8–9 en cada lado, ramificadas y notoriamente anastomosadas, algo prominentes en el envés. Inflorescencias masculinas de 2–3 cm de largo, con indumento esparcido. Inflorescencias femeninas de 2–8 mm de largo, 1–3 flores. Fruto anual, solitario o en pares, subsésil o con pedúnculos de hasta 1 cm de largo, cúpula de 8–18 mm ancho y 5–12 mm de alto, escamas de la cúpula triangular-ovadas hasta oblongas, base engrosada con indumento canescente, ápice elongado y estrecho, rojizo, glabro y adpreso; nuez elipsoide u ovoide, de 8–15 mm de largo y 5–12 mm de ancho, con indumento esparcido, café claro, incluida cerca de la mitad en la cúpula.

Distribución.—Se distribuye en Texas y en las sierras del norte de Coahuila como serranías del Burro, sierra del Carmen, La Encantada, hasta el centro en las sierras de la Madera, San Marcos y La Paila. Forma parte del matorral submontano, en la ecotonía con el matorral rosetófilo, en bosque de encino y bosque de pino-encino. Generalmente se asocia con *Quercus sinuata* var. *breviloba*, *Q. gravesii*, *Q. grisea*, *Q. intricata*, *Q. pungens* var. *vaseyana*, *Q. laceyi*, *Bumelia lanuginosa*, *Ptelea trifoliata*, *Rhus virens*, *R. aromatica*, *Vauquelinia corymbosa*, *Pinus remota*, *Arbutus xalapensis*, *Ungnadia speciosa*, *Cercocarpus montanus*, *Leucaena retusa*, *Cercis canadensis* y *Fraxinus greggii*. También se le puede encontrar en el matorral rosetófilo, donde ocurre en forma esparcida con elementos de *Nolina cespitifera*, *Dasylirion cedrosanum*, *Yucca thompsoniana*, *Leucaena retusa*, *Calia secundiflora* y *Acacia berlandieri*. Sus rangos altitudinales van desde los 750–2200 m en el matorral submontano del noroeste del estado. Se le encuentra en colinas calizas y laderas bajas, en exposiciones norte, noreste u oeste, en los cañones llega a ser un arbolito de 4–6 m. Frecuente en las sierra del Carmen y serranías del Burro, escaso en la sierra La Paila. Especie común en las áreas donde habita. Se reportan algunas introgresiones con *Q. grisea* para Texas (Muller, en prensa).

Notas.—Se reconoce por las hojas coriáceas, oblongas a elípticas, usualmente de menos de 8 cm de largo, margen generalmente entero, ondulado o con pocos dientes, haz verde oscuro, brillante y envés opaco, con indumento denso de pelos multirradiados. Escamas de la cúpula triangulares a rombicas con base engrodasa. Se puede confundir con *Quercus grisea* o *Q. sinuata*.

Material examinado: **Mpio. Acuña:** sierra del Carmen, cañón El Diablo, mina El Popo, 29°12'N y 102°45'W, 1,600 m, 29 jul 1973, *M.C. Johnston et al. 11929* (ANSM); serranias del Burro, rancho El Bonito, 29°01'N y 102°07'W, 1,625 m, 19 sep 1977, *D. Riskind* y *C.H. Muller 2202* (ANSM, TEX). **Mpio. Cuatro Cienegas:** rancho Potero Menchaca, 30 ago 1980, *L. Rodríguez* y *R. Vasquez 39* (ANSM). **Mpio. Muzquiz:** sierra Santa Rosa (La Babia), rancho La Babia, cañón Rincón de María, 28°28'N y 102°04'W, 1,450 m, 27 abr 1975, *T. Wendt* y *D. Riskind 943* (ANSM, TEX); sierra La Encantada, mina Las Cabras, 16 ago 1976, *R. Vasquez s.n.* (ANSM). **Mpio. Zaragoza:** serranias del Burro, rancho Los Potros, 28°55'N y 101°45'W, 1,100 m, 14 jun 1987, *D. Castillo 507* (ANSM).

Quercus muehlenbergii Engelm., Trans. Acad. Sci. St. Louis. 3:391. 1877. (**Fig. 21**).

Quercus prinus L. var. *acuminata* Michx., Hist. Chenes Amer. Sep.. 5:3. 1801.
Quercus acuminata (Michx.) Sarg., Gard. & Forest 8:93. 8:55. 1895.
Quercus brayi Small, Bull. Torrey Bot. Club 28:358. 1901.
Quercus sentenelensis C.H. Mull., Amer. Midl. Naturalist 18:849. 1937.

Árboles de hasta 30 m de alto; corteza café grisácea, delgada, escamas alargadas, angostas y frágiles; ramillas de 1.5–3(–4) mm de grosor, con indumento fino, esparcido o glabras, café; yemas de 3–3.5 mm de largo,esféricas a ovoides, estípulas subuladas de 3–4 mm largo, con indumento esparcido o glabras. Hojas deciduas, delgadas y algo coriáceas; pecíolos de 1–3 cm de largo, glabros o con indumento esparcido; limbos lanceolados, oblanceolados a obovados, de (5–)8–15(–21) cm de largo y (2.5–)4–8(–10) cm de ancho, ápice agudo a acuminado, base cuneada o truncada, margen repando, dentado o con lóbulos poco profundos, redondeados o acuminados y terminando en un mucrón, haz glabro y lustroso de color verde oscuro, envés glauco, con pelos simples y fasciculados con pocos radios, pequeños, esparcidos; nervaduras 8–12 por cada lado, con algunas intermedias, terminando en el margen, ramificadas, un poco elevadas en el haz y prominentes en el envés. Inflorescencias masculinas en amentos de 4–6 cm de largo. Inflorescencias femeninas de 1–3 de 0.5–2 cm de largo. Fruto anual, solitario o en pares, subsésil o con un pedúnculo corto, cúpula de 18–22 mm de ancho y 10–12 mm de alto, escamas triangulares a rombicas, poco engrosadas, con indumento gris; nuez oblonga a ovoide, de 15–20 mm de largo y 10–13 mm de ancho, glabra excepto cerca del ápice, café claro, incluida cerca de un cuarto a un tercio en la cúpula.

Distribución.—Se distribuye por todo el centro-este de los Estados Unidos desde Nuevo México, Texas, Oklahoma, Arkansas, Louisiana, Wisconsin hasta Maine y Ontario en Canadá. En México se distribuye por la Sierra Madre Oriental en los estados de Coahuila y Nuevo León, en Coahuila se encuentra en la sierra del Carmen, del Burro, Santa Rosa, La Madera, La Gloria y La Concordia, en bosques de encino, de pino y de pino-encino. Se asocia con especies de *Quercus gravesii*, *Q. laceyi*, *Q. hypoleucoides*, *Q. mohriana*, *Acer grandidentatum*, *Pinus arizonica* var. *stormiae*, *Cupressus arizonica*, *Prunus serotina*, *Garrya ovata*, *Tilia mexicana*, *Ulmus multinervosa*, *Ungnadia speciosa* y *Juniperus deppeana*. En el sur del estado se asocia además con *Quercus laeta*, *Q. saltillensis*, *Pinus cembroides*, *Juniperus flaccida* y *Arbutus xalapensis*. Su rango altitudinal oscila entre 1300–2800 m, especialmente en lugares protegidos, o en cañones con abundante humedad, sobre laderas altas con exposición noroeste, o bien confinado a los márgenes de arroyos en montañas boscosas, como árbol de 8–15 m. Común en las sierras del Carmen y La Madera, raro en la sierra La Concordia. Especie común en Coahuila, sin llegar a ser abundante.

Notas.—Se reconoce fácilmente por las hojas delgadas, oblanceoladas y grandes, de hasta 21 cm de largo, con ápice agudo, 8–12 pares de nervaduras laterales prominentes, margen lobulado a dentado, pecíolos de 1–3 cm de largo. Escamas de la cúpula triangulares a rombicos, con engrosamiento central.

Material examinado: **Mpio. Acuña:** sierra del Carmen, El Cinco, 28°97'N y 102°57'W, 2,286 m, 3 sep 1997, *G. Harper, J. Medel* y *D. Doan-Cider s.n.* (ANSM); serranias del Burro, rancho El Bonito, cañón El Bonito, 29°01'N y 102°07'W, 1,650 m, 17 sep 1977, *D. Riskind* y *C.H. Muller 2098* (ANSM, TEX). **Mpio. General Cepeda:** sierra La Concordia, 6 km al NE de La Victoria, 25°15'N y 101°20'W, 2,770 m, 29 oct 1987, *J.A. Villarreal et al. 4093* (ANSM). **Mpio. Muzquiz:** sierra Santa Rosa, rancho El Silencio, 27°55'N y 101°50'W, 1,300 m, 2 may 2004, *S. Lara* y *R. Pineda 102* (ANSM); sierra Santa Rosa (La Babia), rancho La Babia, cañón Rincón de María, 28°27'N y 102°04'W, 1,450 m, 17 sep 1999, *J.A. Villarreal et al. 8772* (ANSM).

Quercus oblongifolia Torr., Sitgreaves, Rep. Exped. Zuni & Colo. R. 173, pl. 19. 1853. (**Fig. 22**). Tipo: E.U.A. Arizona: *Woodhouse s.n.* (holotipo: NY; isotipo: MO).

Árbol de 6–10(–16) m de alto, troncos de hasta 30 cm de diámetro, corteza surcada gris o blanquecina; ramillas de 1–1.5 mm de grosor, con pelos fasciculados, esparcidos, glabrescentes, café rojizo, con lenticelas; yemas subesféricas a ovoides, de 1–3 mm de largo, café rojizas, glabras; estípulas de 3–4 mm de largo, subuladas, persistentes. Hojas deciduas, subcoriáceas, subpersistentes; pecíolos de (2–)3–4(–8) mm de largo, puberulentos a glabrescentes, rojizos; limbos oblongos a elípticos, en ocasiones lanceolados u ovados, de (2–)3–6(–8) cm de largo y (0.5–)1–2(–2.5) cm de ancho, ápice redondeado a obtuso, base redondeada, cuneada o cordada, margen engrosado, ligeramente revoluto, entero, ondulado o irregularmente dentado hacia el ápice; haz verde grisáceo a ligeramente azulado, opaco y glabrescente, envés glauco, glabro, o con diminutos pelos fasciculados esparcidos, usualmente restringido a la base del nervio medio; nervaduras 6–8(–10) en cada lado, prominentes en el envés, un poco salientes en el haz, en un retículo blanco y esclerosado. Inflorescencias masculinas de 3–4 cm de largo, raquis puberulento. Inflorescencias femeninas de 2–15 mm de largo con 1–5 flores, pedunculadas. Fruto anual solitario o en pares, subsésil o sobre pedúnculos cortos; cúpula de 10–13 mm de ancho y 6–8(–13) mm de alto, escamas ovado-oblongas, engrosadas, con indumento gris, ápice rojizo; nuez ovoide u oblonga de 12–17(–19) mm de largo y (7–)10–12 mm de ancho, café claro, glabra o con puberulencia cerca del ápice, incluida cerca de un tercio en la cúpula.

Distribución.—Se distribuye desde Arizona, oeste de Texas, Sonora, Baja California, Chihuahua y Durango, donde es abundante. En Coahuila se encuentra en las sierras del centro y noroeste que comprende las sierras de Las Cruces, La Madera, San Antonio y Hechiceros. Crece en comunidades del matorral submontano, bosque de encino y de pino-encino. Se asocia con *Quercus intricata*, *Q. pringlei*, *Q. grisea*, *Lindleya mespiloides*, *Rhus virens*, *R. aromatica*, *Agave falcata*, *Arbutus xalapensis*, *Arctostaphylos pungens*, *Pinus arizonica* var. *stormiae*, *P. remota*, *Garrya ovata*, *Ceanothus greggii*, *Dasylirion cedrosanum* y *Nolina cespitifera*. Con rangos altitudinales de 1550–1900 m, se encuentra en el fondo de cañones con bosque de encino, mientras que en el matorral submontano crece sobre laderas bajas de exposición noroeste y oeste, con suelos derivados de rocas ígneas. Se reporta una población en sierra de Hechiceros con hojas con indumento denso, lo cual parece ser una introgresion con *Q. invaginata* (Muller, en prensa). La especie es rara y poco abundante en Coahuila.

Notas.—Se reconoce por las hojas subcoriáceas, verde grisáceas, oblongas a elípticas de hasta 8 cm de largo, ápice redondeado a obtuso, mergen entero a ondulado, glabras o con pubescencia esparcida y diminuta

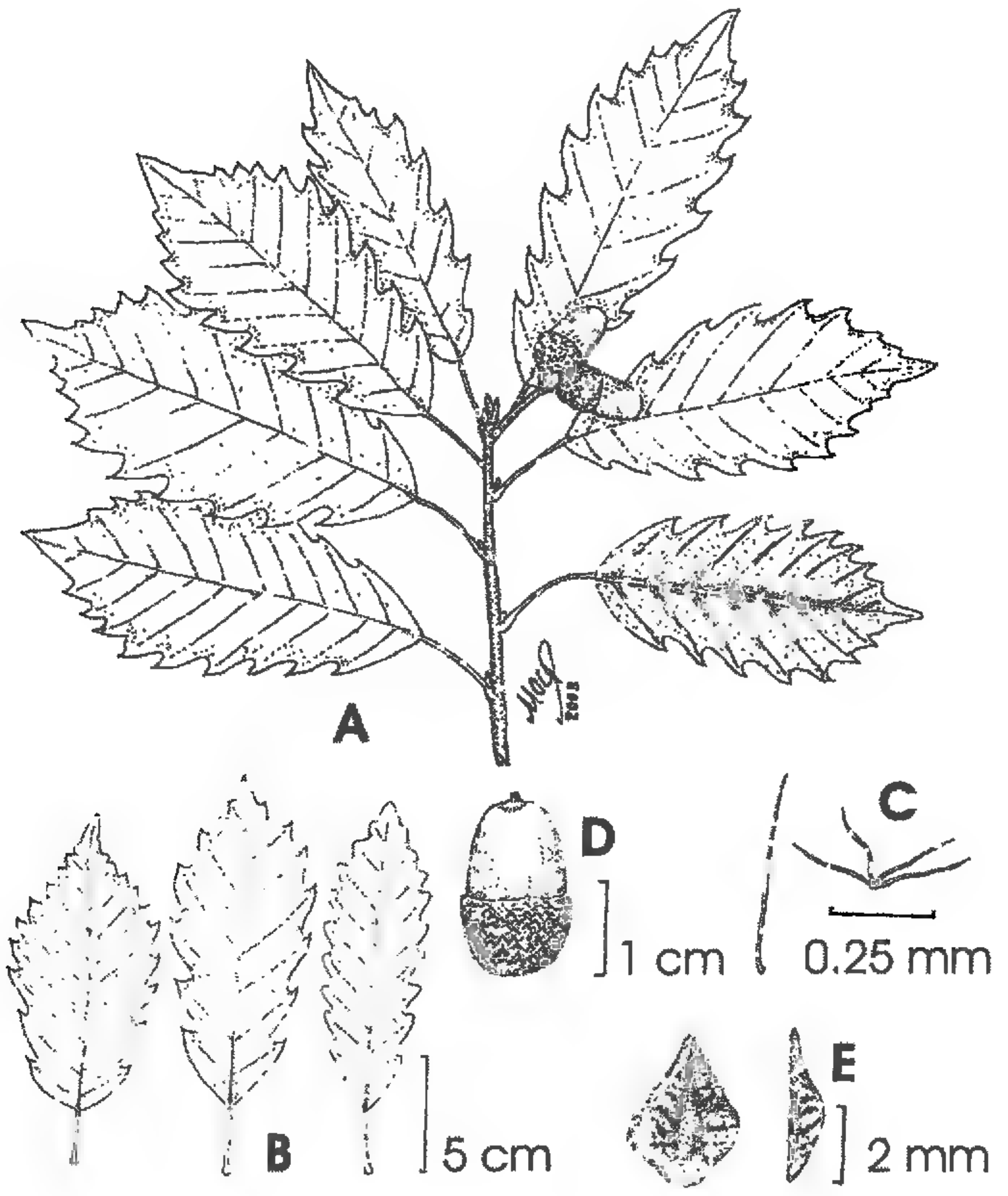
A
B
5 cm
D
1 cm
C
0.25 mm
E
2 mm

Fig. 21. *Quercus muhlenbergii*. **A.** rama con hojas y bellotas; **B,** variación en hojas; **C,** pelos fasciculado y simple; **D,** bellota; **E,** escama de la cúpula, vista frontal y lateral.

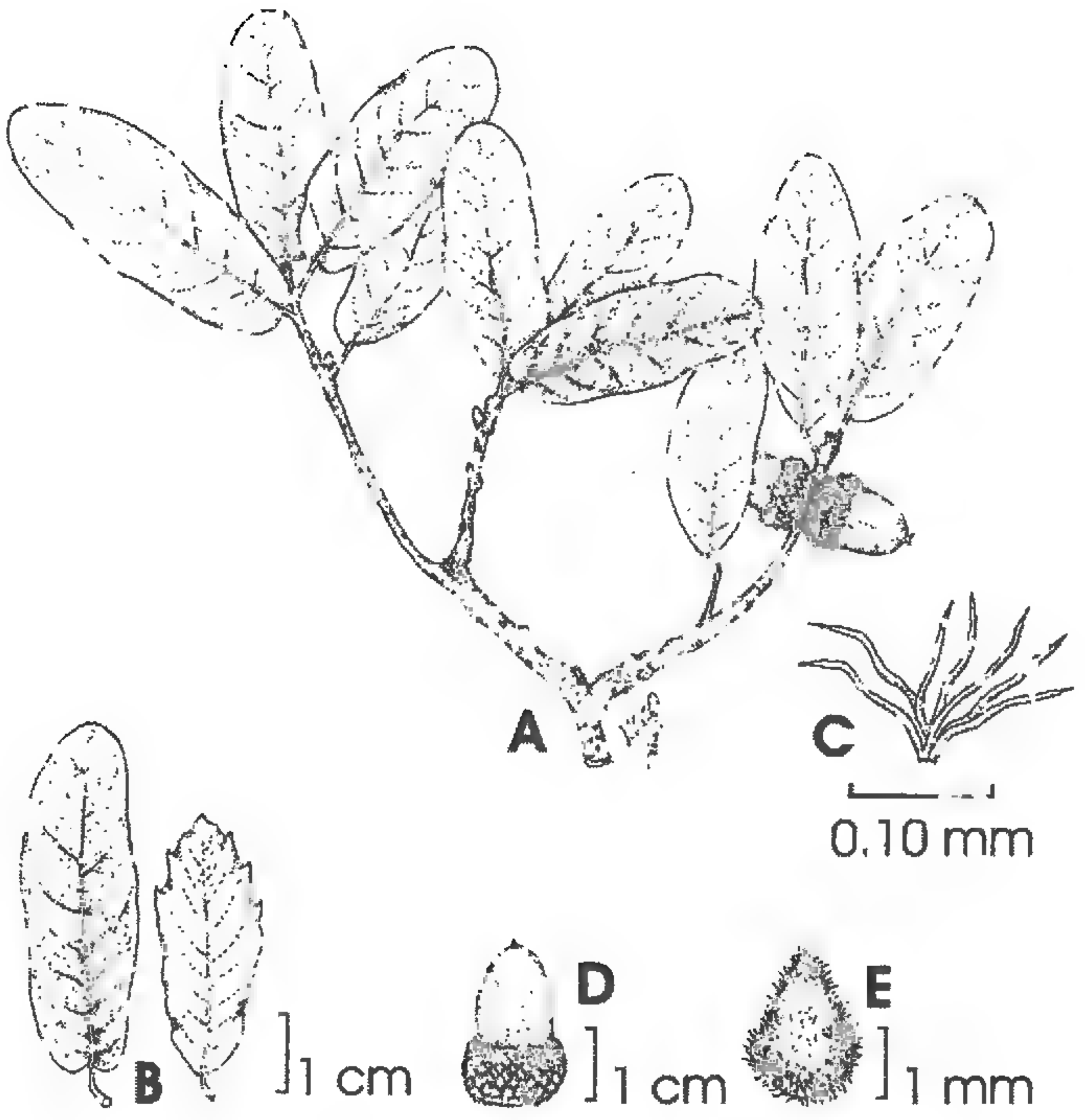
A
C
0.10 mm
B
1 cm
D
1 cm
E
1 mm

Fig. 22. *Quercus oblongifolia*. **A,** rama con hojas y bellotas; **B,** variación en hoja; **C,** pelo fasciculado; **D,** bellota; **E,** escama de la cúpula.

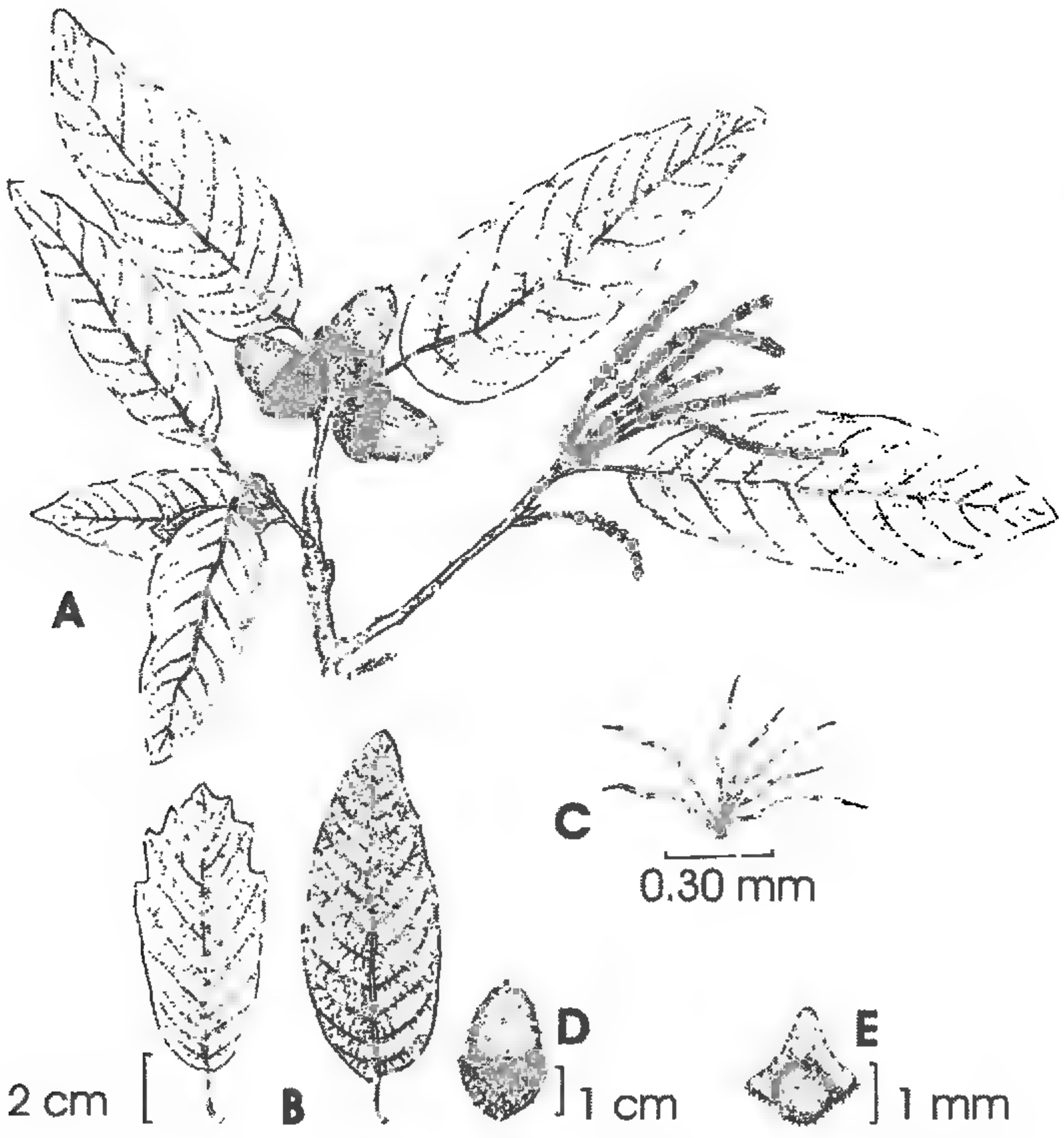
A
C
0.30 mm
2 cm
B
D
1 cm
E
1 mm

Fig. 23. *Quercus polymorpha*. **A,** rama con hojas, amentos y bellotas; **B,** variación en hoja; **C,** pelo fasciculado; **D,** bellota; **E,** escama de la cúpula.

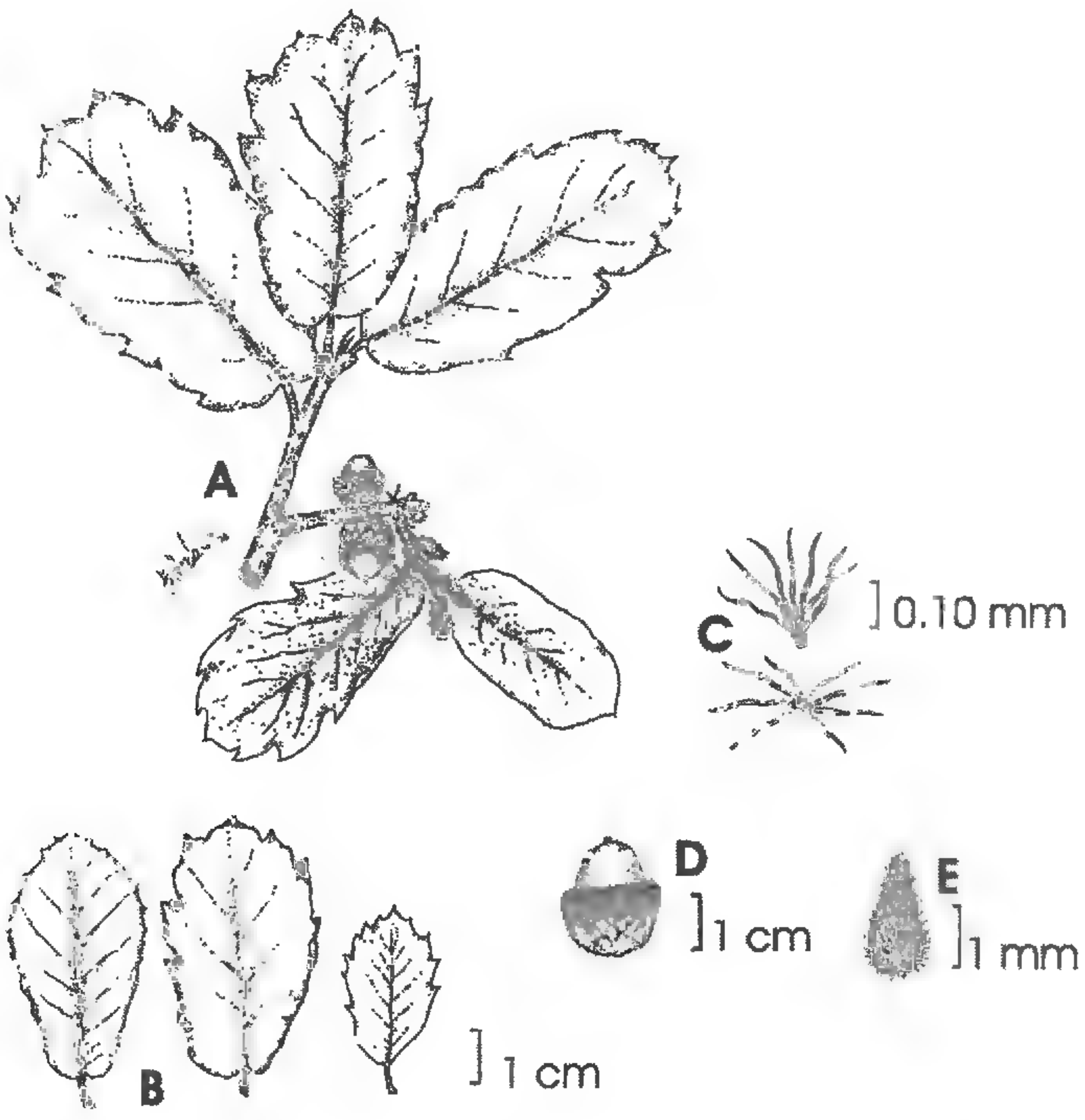
A
C
0.10 mm
D
1 cm
E
1 mm
B
1 cm

Fig. 24. *Quercus potosina*. **A,** rama con hojas y bellotas; **B,** variación en hoja; **C,** pelo fasciculado; **D,** bellota; **E,** escama de la cúpula.

de pelos fasciculados, venación esclerosada. Bellotas con cúpula corta y escamas con engrosamiento central. Algunas muestras pueden presentar algunas semejanzas que lleven a la confusión con *Q. laceyi*.

Material examinado: **Mpio. Cuatro Cienegas:** cañón La Barrica, picacho El Pajarito, 27°01'N y 102°23'W, 2,260 m, 28 ago 1975, *T. Wendt y E. Lott 1344* (ANSM, TEX).

Quercus polymorpha Schltdl. et Cham., Linnaea 5:78. 1830. (**Fig. 23**). Tipo: MÉXICO. Veracruz: Jalapa, hacienda de La Laguna, *C.J.W. Schiede 501B* (holotipo: HAL; isotipo: GH).

Árbol de 10–15(–20) m de alto, con corteza gris, escamosa o surcada; ramillas de 2–3 mm de grosor, de color café rojizas, con indumento amarillento, glabrescentes, con numerosas lenticelas; yemas ovoides, de 3–5(–10) mm de largo, de color café rojizo, con pelos cortos apresados a glabrescentes; estípulas subuladas y pubescentes de 10–13 mm de largo, persisten cerca de las yemas terminales. Hojas deciduas, coriáceas; pecíolos de (6–)15–25(–35) mm de largo, casi glabros, amarillentos, delgados y engrosados en la base; limbos oblongo-elípticos u ovados a lanceolados u obovados de 5–10(–15) cm de largo y 3–6(–8) cm de ancho, ápice angostamente obtuso, rara vez acuminado, base generalmente redondeada a cordada, margen ligeramente cartilaginoso y revoluto, entero o pocos dientes mucronados, localizados en la mitad superior de la hoja; haz verde oscuro y glabro, envés glauco ceroso, opaco, o con indumento gris amarillento de pelos fasciculados; nervaduras 10–12(–14) a cada lado, muy ramificadas y anastomosadas cerca del borde, hundidas en el haz y muy prominentes en el envés, formando un retículo. Inflorescencias masculinas de 6–8 cm de largo, vellosas. Inflorescencias femeninas de 5–10 mm de largo, con una o dos flores. Fruto anual solitario o por pares, sobre pedúnculos de 5–30 mm de largo; cúpula hemisférica de 12–15(–20) mm de diámetro, con escamas engrosadas en la base, agudas y apresadas, blanquecinas; nuez elipsoide de 14–20(–25) mm largo y 8–13 mm de ancho, café claro, incluida aproximadamente la mitad en la cúpula.

Distribución.—Se distribuye desde el suroeste de Texas, Nuevo León, Tamaulipas, Veracruz, San Luis Potosí, Jalisco, Hidalgo, Oaxaca y Chiapas hasta Guatemala. En Coahuila se presenta en la sierra de Pájaros Azules, en el centro del estado, en los límites con el estado de Nuevo León. Crece en bosque de encino asociada con *Q. invaginata*, *Q. laceyi*, *Q. gravesii*, *Q. canbyi*, *Juglans microcarpa*, *Fraxinus greggii*, *Chiococca alba*, *Colubrina greggii*, *Rhus virens*, *Pistacia texana* y *Ungnadia speciosa*, en altitudes entre 700–850 m, sobre laderas bajas y en fondo de cañones húmedos, con exposición norte o noroeste. Especie rara para el área del estado.

Notas.—Se puede reconocer por las hojas coriáceas, verde oscuro, cerosas, oblongo a ovadas, de 5–15 cm de largo, base redondeada a cordada, margen entero o con pocos dientes cortos, envés con nerviacion reticulada resaltada. Bellotas de 15–30 mm largo, escamas de la cúpula triangulares, con tuberculo basal.

Material examinado: **Mpio. Candela:** sierra de Pajaros Azules, rancho Santa María, en los limites con Lampazos N. L. 875 m, 23 nov 2002, *J.J. Medellín V. 433*, 445 (CFNL).

Quercus potosina Trel., Mem. Natl. Acad. Sci. 20:84, pl. 123. 1924. (**Fig. 24**). Tipo: MÉXICO. San Luis Potosi: *C.C. Parry y E. Palmer 838* (holotipo: MO; isotipos: GH, MO).

Quercus potosina Trel. f. *exilis* Trel. Mem. Natl. Acad. Sci. 20:84, pl. 124. 1924.
Quercus potosina Trel. f. *aperta* Trel., Mem. Natl. Acad. Sci. 20:84, pl. 125. 1924.
Quercus cordifolia Trel., Mem. Natl. Acad. Sci. 20:84, pl. 125. 1924.
Quercus jaralensis Trel., Mem. Natl. Acad. Sci. 20:86, pl. 133. 1924.

Arbusto de 1–3 m o raras veces árbol de hasta 7 m de alto; corteza gris, escamosa; ramillas de 1–3 mm de grosor, rojizas, con pelos fasciculados y pelos glandulares cortos; yemas ovoides, de 2–4 mm de largo, grisáceas, pubescentes o glabrescentes; estípulas filiformes a subuladas, de 6–10 mm de largo, pilosas. Hojas persistentes, gruesas y coriáceas; pecíolos de 2–3(–6) mm de largo, con indumento gris persistente, rojizos; limbos obovados, elípticos, hasta suborbiculares, de (2–)3.5–5(–9) cm de largo y (1–)2–3.5(–6) cm de ancho, ápice redondeado hasta agudo, base cordada a redondeada, margen algo revoluto con dientes toscos terminando en mucrones, haz algo lustroso, con pelos fasciculados, envés glauco-ceroso, opaco, con indumento formado de pelos fasciculados estipitados en la base de la nervadura principal y multirradiados cubriendo el limbo, frecuentemente con puntos resinosos color ambar; nervaduras (6–)8(–10) en cada lado, prominentes en el envés, la nervadura media y principales rojizas. Inflorescencias masculinas de 2–2.5 cm de largo, con flores densas, raquis velloso. Inflorescencias femeninas de 2–12 mm de largo, 1–3(–4) flores. Fruto anual, solitario o en grupos de 2–4, subsésil o sobre pedúnculos de hasta 8 mm de largo velloso; cúpula hemisférica de 12–15 mm de ancho, con el margen involuto, las escamas poco engrosadas en la base, con el ápice agudo, un poco apresadas, indumento de pelos cortos y apresados; nuez ovoide, de 12–15 mm de largo y 8–12 mm de ancho, puberulenta o glabrescente, incluida cerca de la mitad en la cúpula.

Distribución.—Se distribuye desde Chihuahua, Durango, Zacatecas, San Luis Potosí, Aguascalientes, Jalisco, Guanajuato, Querétaro e Hidalgo. En Coahuila se encuentra solamente en el extremo sureste del estado en la sierra de Arteaga, colectado en el cañón de Jamé en bosque de pino-encino, asociándose con *Pinus cembroides*, *P. teocote*, *P. pseudostrobus*, *Arbutus xalapensis*, *Arctostaphylos pungens*, *Cercocarpus montanus*, *Quercus saltillensis*, *Q. striatula* y *Q. laeta*. Crece en un rango altitudinal de 2300–2650 m sobre laderas bajas con exposición norte y sureste, en bosques abiertos de pino-encino, como arbusto o arbolito de hasta 5 m de alto. Especie con categoria de rara en Coahuila.

Notas.—Se reconoce por las hojas gruesas obovadas a suborbiculares, usualmente menos de 6 cm de largo, con ápice redondeado, margen con dientes mucronados, envés con pelos fasciculados, multirradiados y puntos amarillos. Cúpulas con con margen involuto y escamas ligeramente engrosadas en la base. Se le puede confundir con *Quercus fulva* por la forma de las hojas.

Material examinado: **Mpio. Arteaga:** sierra de Arteaga, rancho El Tirol, cañón de Jamé, 2,450 m, 24 jun 1994, *J.A. Villarreal et al. 7719* (ANSM), sierra Las Vigas, cañón de Jamé, 25°26'N y 100°20'W, 2,500 m, 8 may 1995, *M.A. Carranza* y *J.A. Encina 2162* (ANSM).

Quercus pringlei Seemen, Bot. Jahrb. Syst. 29:96. 1900. (**Fig. 25**). Tipo: MÉXICO. Coahuila: Carneros Pass, *C.G. Pringle 2382* (lectotipo: B; isotipos: GH, TEX).

Quercus filiformis C.H. Mull., Amer. Midl. Naturalist 27:473. 1942.

Arbusto o árbol pequeño de (0.50–)1–4(–10) m de alto; corteza delgada, fisurada y gris; ramillas de 1–2 mm de grosor, café oscuro a grisáceas, glabrescentes; yemas ovoides de 1–1.5 mm de largo, café oscuro, glabras; estípulas filiformes, de 3–5 mm de largo, glabras. Hojas persistentes y coriáceas; pecíolos de 2–5 mm de largo, indumento esparcido, rojizos; limbos lanceolados hasta estrechamente elípticos u oblongos, de (1–)2–3(–4.5) cm de largo y (0.5–)1–2(–3) cm de ancho, ápice agudo, obtuso o redondeado, mucronado, base redondeada, cuneada o cordada, margen algo engrosado, revoluto o plano, entero, denticulado, a toscamente dentado, dientes mucronados; haz glabro, raramente con indumento diminuto fasciculado, esparcido o restringido al nervio medio, envés verde azuloso, con indumento fasciculado esparcido, glabrescente; nervaduras 7–8(–12) en cada lado, irregulares, ramificadas y anastomosadas cerca del margen, poco salientes. Inflorescencias masculinas 1–2 cm largo, con indumento esparcido. Inflorescencias femeninas 1–2 flores, subsesiles. Fruto anual solitario o en grupos de 2–4, subsésil o en pedúnculos de 1–10 mm de largo; cúpula hemisférica, de 8–10 mm de ancho, escamas con la base engrosada e indumento canescente, ápice café oscuro, delgado, apresado; nuez elíptica de 8–10 mm de largo, glabra, café claro, levemente estriada, incluida de un tercio a un medio en la cúpula.

Distribución.—Se distribuye en Zacatecas, San Luis Potosí, Nuevo León, Coahuila y Durango. En Coahuila se encuentra en el noroeste, centro-oeste del estado en las sierras del Pino, La Madera, hasta el sur y sureste en las sierras de Parras y de Carneros en comunidades de matorral submontano, en bosque de pino piñonero y bosques de encino, asociándose con *Pinus cembroides*, *P. remota*, *Juniperus flaccida*, *J. erythrocarpa*, *Calia secundiflora*, *Lindleya mespiloides*, *Rhus virens*, *Mimosa biuncifera*, *Quercus striatula*, *Q. coahuilensis*, *Agave falcata*, *Cercocarpus fothergilloides*, *Dasylirion cedrosanum* y *Eysenhardtia texana*. Crece en altitudes de 1800–2800 m, donde forma matorrales en sitios con exposiciones norte, noreste y sur, sobre laderas bajas y cimas con poca humedad, en suelos someros y pedregosos, prefiere crecer en lugares abiertos y soleados. Abunda en las sierras del sur del estado y es común en las sierra La Madera y del Pino. Una población de plantas de la sierra La Madera, con tallos postrados, alargados y hojas delgadas, fue descrito como *Quercus* *filiformis* (Johnston 1944). Especie común en las áreas donde habita. Es conocido localmente como: encino chaparro o charrasquillo.

Notas.—Se reconoce por ser generalmente un arbusto bajo, de hojas coriáceas, elípticas a oblongas, usualmente de menos de 3 cm de largo, glabras o casi glabras y venación inconspicua. Bellotas de menos de 1 cm de largo y escamas de la cúpula con base engrosada.

Material examinado: **Mpio. Arteaga:** sierra La Marta, 25°12'N y 100°21'W, 2,920 m, 14 jul 1997, *A. A. Moreno 022* (ANSM). **Mpio. Cuatro Cienegas:** sierra La Madera, cañón de la Barrica, 27°01'N y 102°23'W, 2,300 m, 20 ago 1975, *T. Wendt* y *E. Lott 1216* (ANSM, TEX). **Mpio. General Cepeda:** 30 km al W de General Cepeda 25°19'N y 101°44'W, 1,940 m, 4 sep 1992, *J.A. Villarreal et al. 6537* (ANSM). **Mpio. Parras:** sierra Playa Madero, cañón Pinalosa, ejido Santa Victoria, 25°09'N y 101°34'W, 2,400 m, 6 jun 1995, *M.A. Carranza* y *J.A. Encina 2203* (ANSM). **Mpio. Saltillo:** sierra Catana 25°15'N y 101°12'W, 2,800 m, 29 jul 1992, *J.A. Villarreal et al. 6471* (ANSM), sierra Zapalinamé, cañón de San Lorenzo, 25°23'N y 101°00'W, 1990 m, *M.A. Carranza* y *J.A. Encina 2223* (ANSM), sierra de Carneros, 25°07'N y 101°07'W, 2,100 m, 15 jun 1995, *J.A. Villarreal* y *M.A. Carranza 8184* (ANSM).

Quercus pungens Liebm. var. **pungens**, Overs. Kongel. Danske Vidensk. Selsk. Forh. Medlemmers Arbeider. 171. 1854 (**Fig. 26**). *Quercus undulata* Torr. var. *pungens* (Liebm.) Engelm., Trans. Acad.Sci. St. Louis 3:392. 1877. Tipo: E.U.A. Texas: *C. Wright 664* (isotipo: MO; sintipo: NY).

Arbusto o árbol de 4–6 m de alto; corteza delgada, gris; ramillas de 1–2 mm de grosor, con indumento amarillento; yemas esféricas u ovoides cerca de 2 mm de largo, café rojizo oscuro con indumento esparcido; estípulas subuladas, de 3–4 mm de largo, pubescentes. Hojas persistentes duras y tiesas; pecíolos de 2–3(–10) mm de largo, con indumento amarillento denso; limbos elípticos a oblongos, de 2–4(–9) cm de largo y 1.5–2.5(–4) cm de ancho, ápice agudo u obtuso, terminando en un mucrón, base redondeada o raras veces cuneada, margen crispado, dentado o con lóbulos agudos, terminados en mucrón, ligeramente revoluto, haz opaco o poco lustroso, con pelos estrellados, diminutos, esparcidos, envés canescente, de pelos seríceos simples y pelos estrellados; nervaduras 5–8(–14) en cada lado, muy ramificadas, más evidentes en el envés. Inflorescencias masculinas de 1–2 cm de largo. Inflorescencias femeninas con 1–3 flores. Fruto anual, solitario o en pares, subsésil o sobre pedúnculos de 2–3 mm de largo; cúpula hemisférica, de 10–13 mm de ancho y 6–8 mm de alto; escamas de la cúpula ovadas o con frecuencia estrechas y oblongas, base engrosada, con indumento grisáceo, ápice delgado y apresado, glabrescente o puberulento, café rojizo; nuez ovoide a subcilíndrica, de 8–12 mm de largo y 6–8 mm de ancho, café claro, glabra, incluida una cuarta parte a la mitad en la cúpula.

Distribución.—Se distribuye en Texas, Nuevo México, Arizona y Chihuahua. En Coahuila se encuentra en las sierras del centro-oeste, suroeste y noroeste, como sierra Mojada, Las Cruces, El Pino, La Madera y Jimulco, en el matorral submontano, en la ecotonía con matorral rosetófilo bosque encino y de pino-encino. Se asocia generalmente con *Pinus remota*, *P. johannis*, *Juniperus flaccida*, *Quercus intricata*, *Q. pringlei*, *Q. gravesii*, *Ceanothus greggii*, *Lindleya mespiloides*, *Cercocarpus montanus*, *Garrya ovata*, *Rhus virens*, *Arctostaphylos pungens*, *Acacia greggii*, *Dasylirion cedrosanum*, *Nolina cespitifera* y *Flourensia retinophylla*. Se encuentra en altitudes de 1200–2400 m, sobre laderas bajas, con exposiciones norte, sur y sureste, con suelos superficiales, derivados de rocas calizas o ígneas. En algunas comunidades puede formar un matorral denso de 1–2 m de alto. En arroyos intermitentes presenta un crecimiento de arbolito o árbol de 4–6 m, formando colonias esparcidas. Es frecuente en la sierras ubicadas al oeste del estado.

Notas.—Se reconoce por las hojas coriáceas, duras, verde claro a amarillentas, lustrosas, ásperas al tacto, elípticas a oblongas, usualmente de menos de 4 cm de largo, margen con lóbulos crispados y mucronados (pungentes), indumento de pelos estrellados diminutos y apresados. Bellotas de cerca de 1 cm de largo, subsesiles, con escamas de la cúpula casi circulares, engrosadas y con ápice delgado.

Material examinado: **Mpio. Acuña:** sierra del Carmen, Styrax canyon, 29°11'N y 102°45'W, 1,750 m, 22 sep 1973, *T. Wendt* y *E. Lott 75* (ANSM, TEX). **Mpio. Cuatro Cienegas:** sierra de San Marcos y Pinos, 2,159 m, 14 jul 1999, *R. Marroquín s.n.* (ANSM). **Mpio. Ocampo:** sierra La Encantada, cuesta Malena, 28°35'N y 102°10'W, 21 ago 1994, *M.A. Carranza et al. 114* (ANSM).

Quercus pungens Liebm. var. **vaseyana** (Buckley). C.H. Mull., Contr. Texas Res. Found. Bot. Stud. 1:70. 1951. *Quercus vaseyana* Buckley, Bull. Torrey Bot. Club 10:91. 1883. *Quercus undulata* Torr. var. *vaseyana* (Buckley) Rydb., Bull. N.Y. Bot. Gard. 2:218, pl. 30. 1901. Tipo: E.U.A. Texas: Pecos river, *S.B. Buckley s.n.* (lectotipo: NY, isolectotipo: MO).

Quercus sillae Trel. Mem. Natl. Acad. Sci. 20:102, pl. 171. 1924.

Arbusto o arbolito de 2–3 m de alto; corteza delgada, gris, fisurada; ramillas de 1–1.5 mm de grosor, café rojizo, con pelos estrellados, glabrescentes; yemas ovoides de 1–1.5 mm de largo, café rojizo oscuro o gris; estípulas caducas, subuladas, 3 mm largo, con indumento esparcido. Hojas deciduas; pecíolos de 2–5 mm de largo, con indumento estrellado; limbos coriáceos, lanceolados a oblongos, de 2.5–4(–6) cm de largo y 0.6–2 cm de ancho; ápice agudo o raras veces obtuso, base cuneada a redondeada, margen cartilaginoso y engrosado, casi plano con 3–5 dientes toscos en cada lado o con lóbulos poco profundos, agudos u obtusos y terminando en un mucrón o enteros, haz verde oscuro, lustroso, glabrescente o con tomento estrellado esparcido, envés seríceo, con pelos diminutos estrellados apresados y pelos simples; nervaduras 3–4(–6) en cada lado, ligeramente salientes en el haz, prominentes en el envés, las principales glabras y conspicuas en contraste con el indumento del envés. Inflorescencias masculinas de 2.5–3 cm de largo, con tomentulo corto. Inflorescencias femeninas de 3–5 mm de largo, 1–2 flores. Fruto anual, solitario o en grupos de tres, subsésil o sobre pedúnculos de de 2–3 mm de largo; cúpula hemisférica, de 7–10 mm de ancho y 3–4 mm de alto; escamas de la cúpula ovadas, base engrosada, con pelos cortos, ápice delgado, apresado, rojo oscuro, glabro; nuez subcilíndrica, de 10–12 mm de largo y 5–8 mm de ancho, café claro, glabra, incluida de un tercio a un quinto en la cúpula.

Distribución.—Se distribuye en Texas, Chihuahua, Coahuila y Nuevo León. En Coahuila se le localiza en las sierras del norte, centro y sur, como La Encantada, La Madera, La Gloria, de Parras, en matorral submontano, en la transición hacia el matorral rosetófilo y bosque de pino-encino, asociándose con *Quercus intricata*, *Q. invaginata*, *Q. striatula*, *Q. pungens* var. *pungens*, *Q. mohriana*, *Pinus cembroides*, *P. remota*, *Gochnathia hypoleuca*, *Dasylirion cedrosanum*, *Juniperus flaccida*, *Fraxinus greggii*, *Rhus virens*, *Lindleya mespiloides*, *Cercocarpus montanus*, *Calia secundiflora*, *Acacia berlandieri* y *Ptelea trifoliata*. Esta presente en altitudes de 1050–2500 m, en arroyos intermitentes, cañones o laderas bajas rocosas con exposición norte, sur y oeste. Es común que forme matorrales densos, en arroyos se presenta como arbolito o árbol esparcido de 7–8 m alto. Es frecuente en las sierras del centro-norte y escaso en las sierras al sur del estado.

Notas.—Se reconoce por las hojas coriáceas, duras, verde claro a amarillentas, muy lustrosas, ligeramente ásperas al tacto, elípticas a oblongas, usualmente de menos de 4 cm de largo, limbos casi planos, indumento de pelos estrellados diminutos, apresados y esparcidos. Bellotas de cerca de 1 cm de largo, subsesiles, con escamas de la cúpula casi circulares, engrosadas y con ápice delgado.

Material examinado: **Mpio. Acuña:** sierra del Carmen, San Ysidro ranch, 1,803 m, *G. Harper* y *D. Doan-Crider s.n.* (ANSM). **Mpio. Cuatro Cienegas:** sierra de La Fragua, valle Grande 26°48'N y 102°33'W, 1,700 m, 29 may 1999, *C. Zermeño s.n.* (ANSM). **Mpio Parras:** sierra de Parras, arroyo Seco, 2,500 m, 11 jun1981, *A. Rodríguez* y *M.A. Carranza 778* (ANSM). **Mpio. Ramos Arizpe:** sierra San José de los Nuncios, 1,600 m, *J.A. Villarreal* y *M.A. Carranza 7053* (ANSM). **Mpio. San Pedro:** sierra Las Margaritas, cañón Blanco, 26°32'N y 102°53'W, 1,290 m, 21 oct 2006, *M.A. Carranza et al. 4603* (ANSM). **Mpio. Torreón:** sierra de Jimulco, 25°10'N y 103°15'W, 2,000 m, 26 sep 1995, *J.A. Villarreal* y *M.A. Carranza 8329* (ANSM).

Quercus rugosa Née, Anales Ci. Nat. 3:275. 1801. (**Fig. 27**). Tipo: MÉXICO. Edo. De México: *Née s.n.* (holotipo: MA).

Quercus reticulata Humb. et Bonpl., Pl. Aequin. 2:(35)40, pl. 86. 1809.
Quercus velifera Trel., Mem. Natl. Acad. Sci. 20:73, pl. 90. 1924.
Quercus durangensis Trel., Mem. Natl. Acad. Sci. 20:73, pl. 91. 1924.
Quercus diversicolor Trel., Mem. Natl. Acad. Sci. 20:73, pl. 92–94. 1924.
Quercus rhodophlebia Trel., Mem. Natl. Acad. Sci. 20:74, pl. 95. 1924.
Quercus ariifolia Trel., Mem. Natl. Acad. Sci. 20:74, pl. 97. 1924.

Árbol de (5–)10–30 m de alto; tronco de hasta 1 m diámetro; corteza escamosa café claro a oscuro; ramillas de (1–)2–3(–4) mm de grosor, pubescentes a glabrescentes, con lenticelas color café; yemas ovoides, de 2–5 mm de largo, café; estípulas persistentes, lineares u oblanceoladas de 5–8(–12) mm de largo, pubescentes. Hojas deciduas, muy rugosas; pecíolos de 5–7(–10) mm de largo, pubescentes a glabros, rojizos; limbos gruesos, rígidos y coriáceos, obovados, elíptico-obovados o casi suborbiculares, de 5–10(–20) cm de largo y 3–7(–10) cm de ancho, ápice redondeado u obtuso a veces agudo, base redondeada o cordada, margen usualmente revoluto, engrosado, sinuado o con dientes hacia el ápice de la hoja, los dientes terminan en un mucrón de

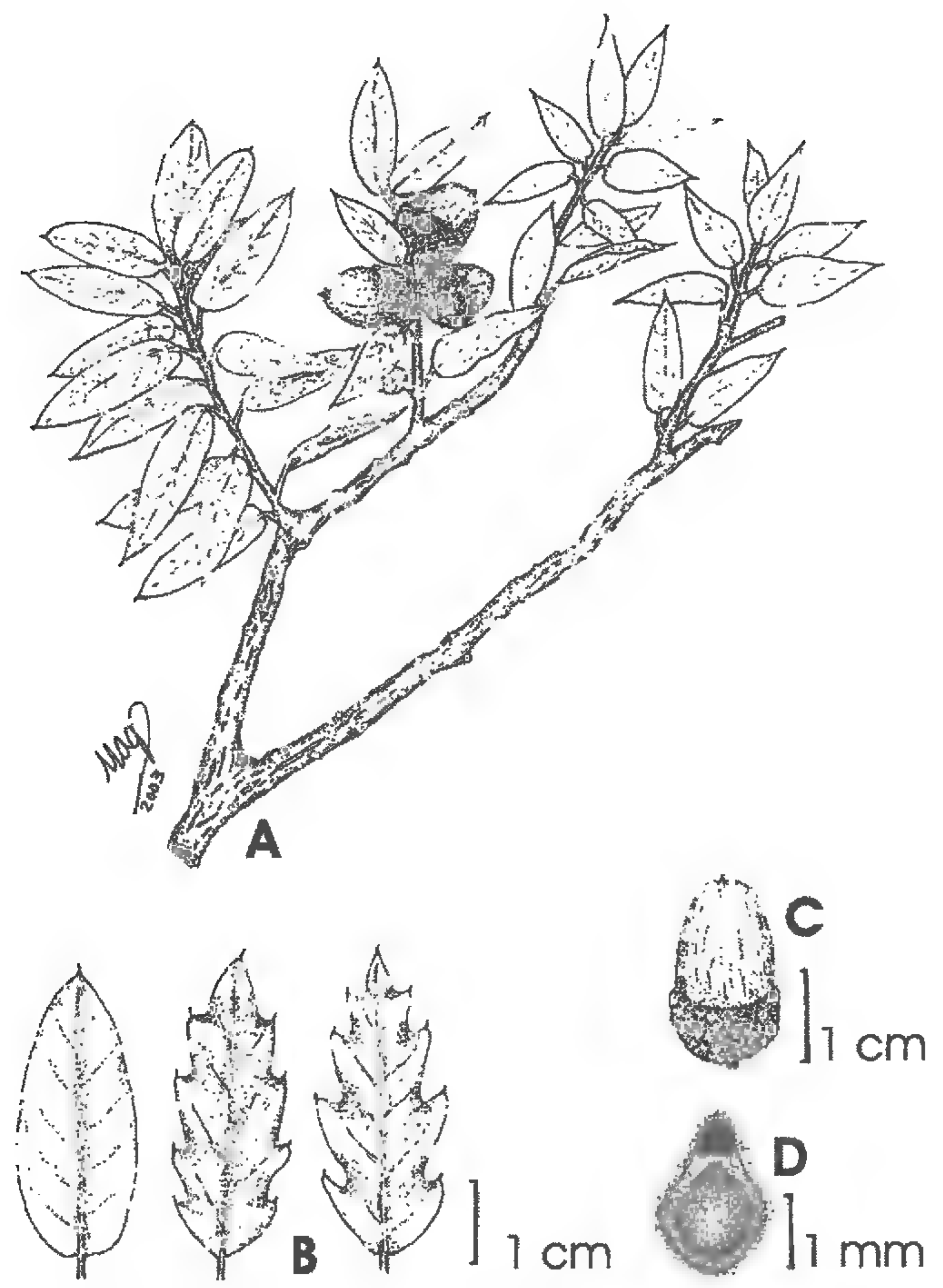
A
C
1 cm
B
1 cm
D
1 mm

Fig. 25. *Quercus pringlei*. **A,** rama con hojas y bellotas; **B,** variación en hojas; **C,** bellota; **D,** escama de la cúpula.

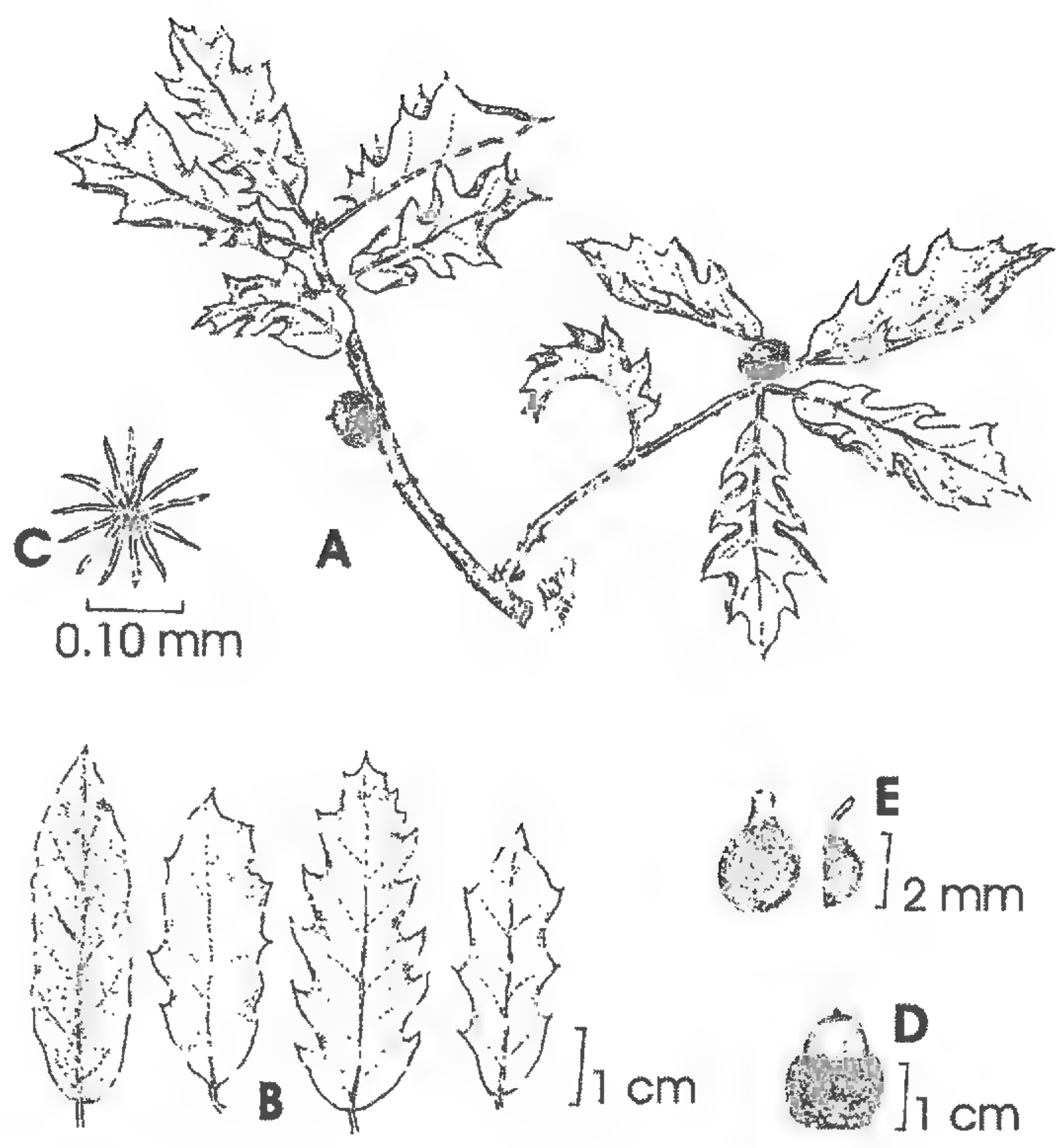
C
0.10 mm
A
E
2 mm
B
1 cm
D
1 cm

Fig. 26. *Quercus pungens*. **A,** rama con hojas y bellotas; **B,** variación en hoja; **C,** pelo estrellado; **D,** bellota; **E,** escama de la cúpula, vista frontal y lateral.

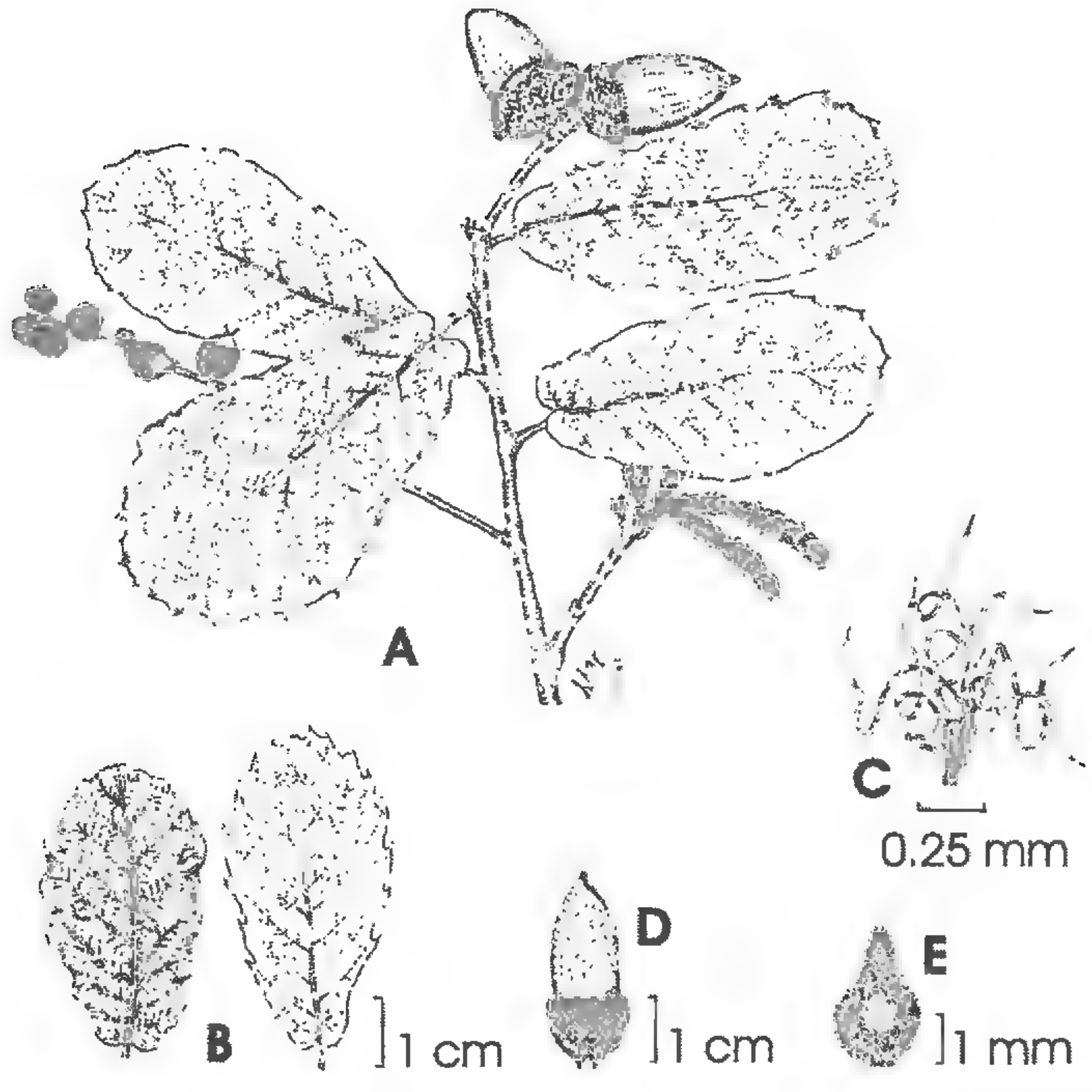
A
C
0.25 mm
B
1 cm
D
1 cm
E
1 mm

Fig. 27. *Quercus rugosa*. **A,** rama con hojas, amentos y bellotas; **B,** variación en hoja; **C,** pelo fasciculado con radios enredados; **D,** bellota; **E,** escama de la cúpula.

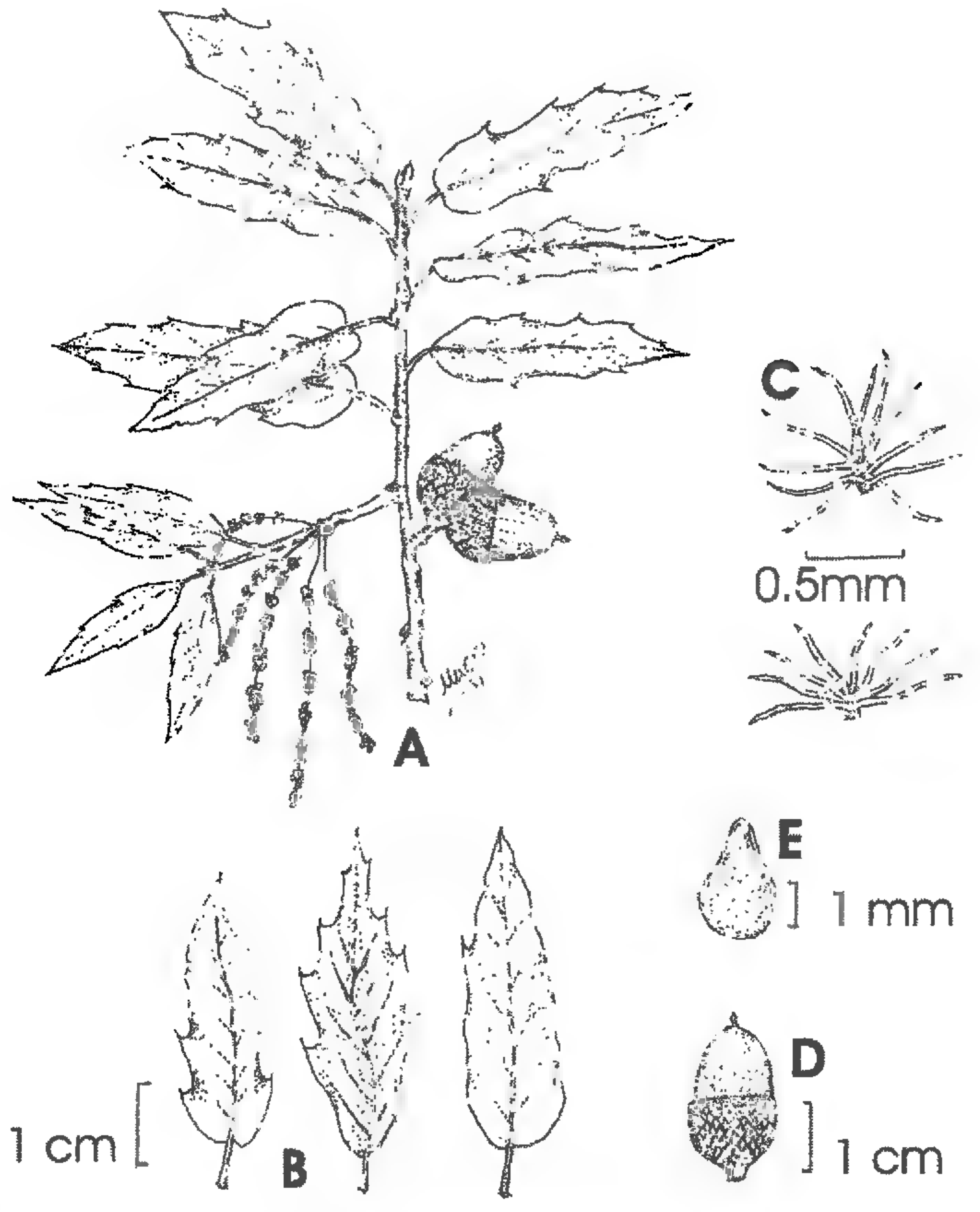
C
0.5mm
A
E
1 mm
1 cm
B
D
1 cm

Fig. 28. *Quercus saltillensis*. **A,** rama con hojas, amentos y bellotas; **B,** variación en hoja; **C,** pelos fasciculado y fasciculado columnar; **D,** bellota; **E,** escama de la cúpula.

1–2 mm, envés cóncavo a plano, haz verde oscuro y algo lustroso, glabro o con pelos glandulares y pelos fasciculados a lo largo del nervio medio, envés con indumento formado por pelos fasciculados con radios algo enredados y pelos glandulares vermiformes, amarillo rojizos, epidermis glauco-cerosa, marcadamente ampulosa y papilosa; nervaduras 8–10(–12) en cada lado, ramificadas, impresas en el haz, muy prominentes en el envés, formando un retículo. Inflorescencias masculinas de 3–5 cm de largo, con tomento fasciculado. Inflorescencias femeninas de 5–10 cm de largo, con pedúnculo delgado pubescente, 15–20 flores. Fruto anual, solitario o en grupos de 2–5(–8) sobre pedúnculos de (1.5–)6–10 cm de largo; cúpula hemisférica de 8–15 mm de ancho y 6–10 mm de alto; escamas de la cúpula con el ápice delgado, café y glabras, bases engrosadas con tomento canescente; nuez ovoide a elíptica de 9–28 mm largo y 7–14 mm de ancho, café claro y glabra, incluida cerca de la mitad en la cúpula.

Distribución.—Se distribuye desde Arizona, Nuevo México y Texas, Baja California, Chihuahua, Durango, San Luis Potosí, Aguascalientes, Colima, Jalisco, Michoacán, Guanajuato, Querétaro, Estado de México, Hidalgo, Tlaxcala, Puebla, Veracruz, Distrito Federal, Morelos llega hacia el sur hasta Oaxaca, Chiapas y Guatemala. En Coahuila se encuentra al norte del estado en la sierra del Carmen y al sureste en la sierra de Zapalinamé, en bosques de encino y pino-encino. Se asocia con especies de *Quercus carmenensis*, *Q. grisea*, *Q. gravesii*, *Q. muehlenbergii*, *Q. arizonica*, *Q. mexicana*, *Q. saltillensis*, *Q. sideroxyla*, *Arbutus xalapensis*, *Pinus arizonica* var. *stormiae*, *Pseudotsuga menziesii*, *Arctostaphylos pungens*, *Cercis canadensis*, *Acer grandidentatum*, *Prunus serotina*, *Fraxinus cuspidata*, *Garrya glaberrima*, *Cupressus arizonica* y *Salix lasiolepis*. Se le encuentra en sitios con elevaciones generalmente de 2000–2700 m, en laderas altas con exposición norte y noroeste, así como en cañones húmedos y márgenes de arroyos, forma bosques densos de árboles de hasta 10 m de alto. Es frecuente en algunas localidades de la sierra del Carmen y en el cañón de San Lorenzo en la sierra de Zapalinamé. La especie se considera rara en el área del estado.

Notas.—Se reconoce fácilmente por sus hojas coriáceas, gruesas, rugosas, verde oscuro y usualmente concavas, obovadas a suborbiculares, generalmente menos de 10 cm de largo, ápice redondeado a obtuso, margen con dientes cortos mucronados, envés con pelos glandulares y pelos fasciculados con radios rizados. Bellotas de 1–3 cm de largo, en racimos largos (hasta 10 cm de largo), escamas de la cúpula con base tuberculada.

Material examinado: **Mpio. Ocampo:** sierra del Carmen, 28°58'N y 102°33'W, 2,200 m, 16 ago 1975, *M.F. Robert y J. Passini 6602* (ANSM), sierra del Carmen, El Jardín, 2,200, 8 jun 1991, *J.A. Pérez 1767* (ANSM). **Mpio. Saltillo:** cañón de San Lorenzo, 25°20'N y 100°57'W, 2,292 m, 20 jul 2000, *J.A. Encina 168, 497* (ANSM).

Quercus saltillensis Trel., Mem. Natl. Acad. Sci. 20:183, pls. 368, 369. 1924. (**Fig. 28**). Tipo: MÉXICO. Coahuila: Carneros Pass, *E. Palmer 1277* (holotipo: GH; isotipo: MO).

Quercus carnerosana Trel., Mem. Natl. Acad. Sci. 20:183, pl. 369. 1924. Tipo: MÉXICO. Coahuila: Carneros Pass, *C.G. Pringle 2802* (holotipo: AA).

Arbusto o arbolito 1–5 m de alto, con corteza obscura fisurada; ramillas de (1–)1.5–2.5 mm de diámetro, con indumento blanquecino de pelos fasciculados café-rojizos; yemas ovoides, de 3 mm largo y 2 mm de diámetro, escamas fimbriadas, café claro; estípulas caedizas. Hojas deciduas y delgadas; pecíolos de 3–9 mm de largo, glabros; limbos lanceolados a oblongo-lanceolados, de 2–4.5(–8) cm de largo y 0.8–2(–3.0) cm de ancho, ápice agudo a atenuado, aristado, base redondeada o cordada, margen algo cartilaginoso, plano, entero o con dientes poco a muy evidentes, aristados; haz verde oscuro, lustroso, glabrescente, envés con indumento blanquecino, denso, glabrescente, con pelos fasciculados simples y pelos con 2 fasciculos, en las axilas del nervio medio; nervaduras 6–10 en cada lado, levemente prominentes en el envés. Inflorescencias masculinas 3–5 cm de largo, con indumento esparcido, lóbulos del cáliz fimbriados. Inflorescencias femeninas de 5–15 mm de largo, con 1–2 flores sobre pedúnculos puberulentos o glabros. Fruto anual, solitario o en pares, sobre un pedúnculo de 3–7 mm de largo; cúpula hemisférica o turbinada, de 5–10 mm de alto y 7–12 mm de ancho; escamas casi planas, con indumento amarillo-rojizo, ápice agudo, café; nuez ovoide, de 8–15 mm de largo y 6–9 mm de ancho, café claro, casi glabra, incluida cerca de un tercio a la mitad en la cúpula.

Distribución.—Se distribuye en el sur y sureste de Coahuila en las sierras de Arteaga, La Concordia, Parras, Carneros, Zapalinamé, se extiende a la sierra La Paila y hasta la sierra de Astillero al norte de Zacatecas, al cerro El Águila en San Luis Potosí y a través de la Sierra Madre Oriental al centro-suroeste de Nuevo León. Crece en bosques de pino-encino, de encino, y en la transición entre el bosque de pino-encino y oyamel, asociándose con *Pinus cembroides*, *P. pseudostrobus*, *Pseudotsuga menziesii*, *Cupressus arizonica*, *Quercus hintoniorum*, *Q. mexicana*, *Q. greggii*, *Q. laeta*, *Q. striatula*, *Juniperus flaccida*, *J. erythrocarpa*, *Prunus serotina*, *Ceanothus buxifolius*, *Juglans microcarpa* y *Arctostaphylos pungens*, en exposiciones sur y sureste se asocia con algunas especies de la familia Agavaceae. Se presenta entre 1900–2800 m, en laderas medias y bajas, con exposiciones norte y noroeste. En lugares húmedos es un arbolito, mientras en los límites del bosque de pino-encino y de oyamel se presenta como arbusto. Es abundante en las sierras de Arteaga, Zapalinamé y La Concordia, mientras que en la sierras La Paila y de Parras, es escaso.

Notas.—Se reconoce por las hojas delgadas, verde oscuro, lanceoladas a oblongas, usualmente de menos de 5 cm de largo, apice generalmente agudo, margen entero entero o con dientes aristados, envés con pelos fasciculados simples y pelos fasciculados dobles. Escamas de la cúpula casi planas. Puede confundirse con *Quercus mexicana* o *Q. striatula* por la forma de las hojas.

Material examinado: **Mpio. Arteaga:** Los Lirios-El Cercado, 2,410 m, 29 jul 1995, *G.B. Hinton 25439* (ANSM), Las Vigas, cañón La Carbonera, 25°20'N y 100°39'W, 2,300 m, 5 jun 1987, *J.A. Villarreal* y *M.A. Carranza 3742* (ANSM), sierra de Arteaga, cañón Jamé, 25°26'N y 100°30'W, 2,600 m, 13 ago 1996, *J.A. Villarreal* y *J. Zavala 8406* (ANSM). **Mpio. General Cepeda:** sierra La Concordia, ejido La Casita, 25°14'N y 101°25'W, 2,200 m, 10 oct 1996, *J.A. Encina* y *J. Zavala 178, 274* (ANSM). **Mpio. Parras:** sierra de Parras, ejido El Capulín, 25°23'N y 102°13'W, 2,050 m, 6 may 1983, *A. Rodríguez et al. 875* (ANSM). **Mpio. Ramos Arizpe:** sierra La Paila, La Sauceda, 14 nov 1965, *J. Marroquín 1063* (ANSM). **Mpio. Saltillo:** sierra de Zapalinamé, cañón Boca Negra, 25°21'N y 100°55'W, 2,270 m, *J.A. Encina* y *R. Cardenas 642* (ANSM), sierra Zapalinamé, lomas de Lourdes, 1,800 m, 19 may 1974, *J. Marroquín 2759* (ANSM).

Quercus sideroxyla Humb. et Bonpl., Pl. Aquinoct. 2:(34)39, pl. 85. 1809. (**Fig. 29**). TIPO: MÉXICO. GUANAJUATO: Villalpando, *A. Humboldt y A. Bonpland s.n.* (HOLOTIPO: P).

Quercus omissa A. DC., Prodr. (DC.) 16 (2.1):28. 1864.
Quercus epileuca Trel., Mem. Natl. Acad. Sci. 20:126, pl. 229. 1924.
Quercus incarnata Trel., Mem. Natl Acad. Sci. 20:127, pl. 231. 1924.

Árbol de 5–10(–20) m de alto, con troncos de 0.5–1.0 m de diámetro, corteza grisácea, gruesa y agrietada; ramillas de 2–3 mm de grosor, gris oscuro, con puberulencia negra; yemas ovoides, de 2.5 mm de largo; estípulas filiformes, caedizas. Hojas gruesas y rígidas; pecíolos de 3–6(–10) mm de largo, pubescentes, con puberulencia negra; limbos oblanceolados a obovados o elíptico-oblongos de (2.5–)4–6(–10) cm de largo y (1–)2–4(–5) cm de ancho, ápice agudo a obtuso, base redondeada o cordada, margen cartilaginoso, engrosado y revoluto, denticulado o con dientes prominentes en la mitad distal, cortamente aristados, haz opaco, verde amarillento, glabrescente, con pelos fasciculados, usualmente restringidos al nervio principal, envés cubierto por indumento denso y persistente, blanco amarillento a café pálido, con pelos fasciculados, con radios ondulados, epidermis con ampulas o papilas prominentes; nervaduras 5–7(–9) en cada lado, ramificadas, alcanzando el diente o anastomosadas cerca del margen, algo impresas en el haz, prominentes en el envés. Inflorescencias masculinas cerca de 4 cm de largo, con tomento fasciculado, con muchas flores. Inflorescencias femeninas de 5–12 mm de largo, 1–2 flores. Fruto anual o bianual (flores y frutos contemporáneos), solitario o en pares, sésiles o con pedúnculos de 1–10 mm de largo, cúpula hemisférica, de 7–13 mm ancho y 4–7 mm de alto, escamas delgadas, obtusas, café claro y glabras o con indumento escaso, con una costilla media tenue; nuez ovoide, café claro, de 10–13 mm de largo y 10 mm de ancho, con puberulencia gris, glabrescente, incluida cerca de un tercio en la cúpula.

Distribución.—Se distribuye en la Sierra Madre Occidental en los estados de Chihuahua, Durango, Michoacán, Zacatecas, Aguascalientes, Guanajuato, en la Sierra Madre Oriental desde Coahuila, Nuevo León y San Luis Potosí. En Coahuila solamente se encuentra en la sierra del Carmen, en bosque de pino-encino, asociado con *Quercus rugosa*, *Q. carmenensis*, *Q. hypoleucoides*, *Cupressus arizonica*, *Arctostaphylos pungens*, *Garrya ovata*, *Pinus strobiformis*, *Pinus greggii*, *Pseudotsuga menziesii*. Crece entre 2300–2600 m de altitud, en valles intermontanos altos y laderas altas con exposición norte o noroeste. En cañones, es frecuente se desarrolle como árbol de hasta 10 m de alto. Especie rara en el estado.

Notas.—Se le puede reconocer por los pecíolos con puberulencia negra, las hojas gruesas, oblongas a obovadas, generalmente de menos de 6 cm de largo, margen revoluto, dentado con aristas cortas, envés amarillento con nervaduras prominentes y pelos fasciculados multirradiados. Escamas de la cúpula con una costilla tenue. Se puede confundir con *Quercus hintoniorum* o *Q. hypoxantha* por la forma de las hojas.

Material examinado: **Mpio. Acuña:** sierra del Carmen, campo Dos, 28°59'N y 102°36'W, 2,270 m, 9 ago 2004, *D. Riskind et al. 2975* (ANSM).**Mpio. Arteaga:** sierra Rancho Nuevo, al E del ejido San Juan de Dolores, 25°25'N y 100°33'W, 2,660 m, 22 sep 2001, *J.A. Encina* y *S. Cruz 959* (ANSM).**Mpio. Saltillo:** sierra Zapalinamé, cañón de San Lorenzo, 25°20'N y 100°55'W, 2,532 m, 6 jul 2000, *J.A. Encina* y *R. Cardenas 455* (ANSM).

Se reportan lo que al parecer son híbridos entre *Quercus sideroxyla* y *Q. mexicana*: **Mpio. Arteaga:** sierra de Artega, cañón La Carbonera, 25°16'N y 100°35'W, 2,150 m, 21 jun 1995, *J.A. Encina et al.161* (ANSM), San Francisco Tarcuy, 2,285 m, 29 oct 1994, *G.B. Hinton 24926* (ANSM)

Quercus sinuata Walter, Fl. Carol. 235. 1788. (**Fig. 30**).

Quercus durandii Buckley, Proc. Acad. Nat. Sci. Phila. 12:445. 1860.

Se distribuye en el sur de Estados Unidos desde el sur de Carolina hasta el centro y oeste de Texas, llegando al noreste de México a los estados de Coahuila, Nuevo León y Tamaulipas.

Quercus sinuata Walter var. **breviloba** (Torr.) C.H. Mull. in I.M. Johnst., J. Arnold Arbor. 25:439. 1944.

Quercus obtusifolia D. Don var. *breviloba* Torr., U. S. Mex. Bound. Surv, Rpt., 2:206. 1859. *Quercus breviloba* (Torr.) Sarg., Gard. & Forest 8:93. 1895. *Quercus durandii* Buckley. var. *breviloba* (Torr.) Palmer, Amer. Midl. Naturalist 33:516. 1945.

Quercus annulata Buckley, Proc. Acad. Sci. Phila. 445. 1860.
Quercus san sabeana Buckley, in Young, F. Tex. 507. 1873.

Arbusto, raras veces árbol de hasta 5 m de alto; corteza gris, delgada y frágil; ramillas de 2–3 mm de grosor, café grisáceo, glabras o con pelos esparcidos; yemas de 2–3 mm de largo, ovoides, glabras o con indumento esparcido, café-rojizas; estípulas caedizas, de 3–5 mm de largo, filiformes y liguladas, pubescentes. Hojas deciduas, delgadas y flexibles; pecíolos de 2–3 mm de largo, glabros o pubescentes; limbos, obovados a oblanceolados u oblongos, de (–2.5)3–6(–8) cm de largo y 2–4 cm de ancho ápice redondeado, base cuneada u obtusa, raras veces atenuada, margen plano, entero a irregularmente dentado y moderadamente lobulado, haz glabro y lustroso, o con pelos esparcidos, envés opaco, canescente, con indumento de pelos fasciculados diminutos, apresados, y pelos simples en la nervadura media; nervaduras 7–11 en cada lado, frecuentemente con intermedias, ramificadas y anastomosadas hacia el margen, algo salientes en el haz, muy prominentes en el envés. Inflorescencias masculinas de hasta 8 cm de largo, con flores laxas. Inflorescencias femeninas de 3–7 mm de largo, 1–3 flores, con indumento denso. Fruto anual, solitario o en pares, subsésil o sobre pedúnculos pubescentes de hasta 7 mm de largo; cúpula de 10–12 mm de ancho y 6–8 mm de alto; escamas de la cúpula ovadas, obtusas, bases engrosadas y pubescentes, el ápice delgado y puberulento, café rojizo; nuez ovoide a elipsoide de 7–15 mm de largo y 7–10 mm de ancho, glabra, café claro, incluida cerca de un cuarto en la cúpula.

Distribución.—Se distribuye en Oklahoma, Texas, Coahuila, Tamaulipas y el centro de Nuevo León. En Coahuila se encuentra en las sierras del Carmen, Santa Rosa (sierra de San Manuel) y La Gavia (sierra del Oso), forma parte del matorral submontano, bosque de encino y bosque de pino-encino. Se asocia generalmente con *Quercus invaginata*, *Q. morhiana*, *Q. arizonica*, *Q. laceyi*, *Q. gravesii*, *Rhus virens*, *R. aromatica*, *Bumelia lanuginosa*, *Colubrina greggii*, *Juniperus flaccida*, *Pinus remota*, *Leucaena glauca* y *Ungnadia speciosa*. Se presenta entre 1200–1600 m de altitud, en laderas bajas con exposición norte y noreste, en cañones o laderas con rocas calizas. Frecuente en las sierras del norte, su abundancia disminuye hacia las sierras del centro del estado. Especie poco abundante en el área del estado.

Notas.—Se reconoce por las hojas delgadas, lustrosas y casi glabras, oblongas a obovadas, generalmente de menos de 6 cm de largo, ápice obtuso a redondeado y base cuneada, margen entero, dentado a cortamente lobulado, envés con pelos fasciculados, diminutos y escasos. Bellota ovoide (corta y ancha) con escamas de la cúpula con base engrosada. Se le puede confundir con *Quercus grisea* o *Q. mohriana* e incluso con *Q. laceyi*, por la forma de las hojas.

Material examinado: **Mpio. Muzquiz:** sierra Santa Rosa, hacienda La Babia, cañón Rincón de Maria, 28°28'N y 102°02'W, 1,200 m, 27 abr 1975, *T. Wendt* y *D. Riskind 959* (ANSM, TEX).

Quercus striatula Trel., Mem. Natl. Acad. Sci. 20:93, pl. 151. 1924. (**Fig. 31**). Tipo: MÉXICO. Durango: *R. Endlich s.n.* (holotipo: B).

Quercus cordifolia Trel., Mem. Natl. Acad. Sci. 20:84, pl. 125. 1924. Tipo: MÉXICO. Coahuila: Carneros Pass, *E. Palmer 1278* (isotipo: GH).
Quercus microphylla Neé, Anal. Cienc. Nat. 3:264. 1801.
Quercus striatula Trel. f. *otinapensis* Trel., Mem. Natl. Acad. Sci. 20:94, pl. 152. 1924.

Arbusto o arbolito de (0.3–) 0.5–2.5 m de alto, con crecimiento colonial rizomatoso; ramillas de 1–2 de mm grosor, amarillo rojizo, glabrescentes; yemas ovoides, de 1–1.5 mm de largo, café rojizo, con las escamas ciliadas; estípulas de 1–5 mm de largo, filiformes o subuladas, caedizas. Hojas deciduas, planas, un poco coriáceas; pecíolos de 1.5–3 mm de largo, pubescentes; limbos oblongos hasta ovados o lanceolados de (1–)2–3(–4) cm de largo y (0.5–)1–2 cm de ancho, ápice agudo a obtuso, mucronado, base redondeada a cordada, margen entero o con pocos dientes toscos y mucronados, en ocasiones ondulado, haz opaco a poco lustroso, verde a verde grisáceo con pelos fasciculados esparcidos, envés con indumento gris-amarillento, denso, de pelos fasciculados estipitados; nervaduras de 6–8(–10) en cada lado. Inflorescencias masculinas cerca de 2 cm de largo, raquis pubescente. Inflorescencias femeninas de (4–)10–20(–40) mm de largo, con 1–2(–8) flores. Fruto anual, solitario o en pares, subsésil o sobre pedúnculos de 4–8(–12) mm de largo, cúpula hemisféricas de 8–12 mm de ancho y 5–7 mm de alto, las escamas engrosadas en la base con indumento denso, ápice delgado y glabro, de color café rojizo, flojamente apresadas; nuez ovoide o subesferica, de 8–12 mm de largo y 7–10 mm de ancho, glabra, café claro, incluida de un tercio a un cuarto en la cúpula.

Distribución.—Se distribuye en San Luis Potosí, Zacatecas, Durango y Nuevo León. En Coahuila se encuentra en el sur y sureste del estado, en las sierras de Jimulco, Parras, La Concordia, Carneros, Zapalinamé, Arteaga, llega hasta el centro en la sierra La Paila, en comunidades del matorral submontano, bosque de pino y en bosque de pino piñonero. Generalmente se asocia con *Quercus pringlei*, *Q. intricata*, *Q. saltillensis*, *Rhus virens*, *Dasylirion cedrosanum*, *Purshia plicata*, *Juniperus saltillensis*, *Calia secundiflora*, *Lindleya mespiloides*, *Agave scabra*, *Pinus cembroides* y *Mimosa biuncifera*. Se desarrolla en altitudes entre 1800–2700 m, como un arbusto o subarbusto rizomatoso, formando parte de los matorrales en las laderas de colinas y montañas, en las exposiciones noreste, este y oeste, con suelos someros. Crece en el matorral submontano y el bosque de pino piñonero en las sierras ubicadas en el sur del estado, ocasionalmente se le encuentra a orillas del bosque de pino, de pino-encino y de oyamel, es escaso en la sierra La Paila.

Notas.—Se puede reconocer las hojas delgadas, verde grisáceas, lanceoladas a oblongas, menos de 4 cm de largo, ápice agudo a obtuso y base cordada a redondeada, margen entero o con dientes mucronados, envés amarillento con indumento denso de pelos fasciculados. Escama de la cúpula con base engrosada. Se puede confundir con *Quercus saltillensis* por la forma de las hojas.

Material examinado: **Mpio. Arteaga:** sierra de Arteaga, cañón de Jamé, 25°26'N y 100°30'W, 2,600 m, 13 ago 1996, *J.A. Villarreal* y *J. Zavala 8404* (ANSM), La Siberia, 25°15'N y 100°29'W, 2,400 m, 21 jun 1995, *J.A. Encina et al. 156* (ANSM). **Mpio. Castaños:** sierra La Gavia, rancho la Gavia, 26°10'N y 101°18'W, 1,500 m, 10 ago 1995, *M.A. Carranza* y *J. Encina 173* (ANSM). **Mpio. General Cepeda:** sierra La Concordia, ejido La Casita, 25°13'N y 101°25'W, 2,200 m, 27 sep 1996, *J.A. Encina* y *J. Zavala 183* (ANSM). **Mpio. Saltillo:** rancho Los Angeles, 25°06'N y 101°06'W, 2,100 m, 11 nov 1994, *J.A. Encina 130* (ANSM), sierra de Zapalinamé, El Penitente, 25°21'N y 100° 55'W, 2,445 m, 15 sep 2005, *J.A. Encina et al.1494* (ANSM). **Mpio. Torreón:** sierra de Jimulco, camino hacia la cima, 25°10'N y 103°15'W, 2,000 m, 26 sep 1995, *J.A. Villarreal* y *M.A. Carranza 8324* (ANSM)

Quercus tuberculata Liebm., Overs. Kongel. Danske Vidensk. Selsk. Forh. Medlemmers Arbeider. 181. 1854. (**Fig. 32**). Tipo: MÉXICO. Sinaloa?: between Mazatlán and Durango, *B.C. Seemann 1970* (holotipo: K; isotipo: GH).

Quercus idonea Goldman, Contr. U.S. Natl. Herb. 16:321. 1916.
Quercus standleyi Trel., Contr. U.S. Natl. Herb. 23:181. 1922.
Quercus monterreyensis Trel. et C.H. Mull., Bull. Torrey Bot. Club 63:151. 1936.

Árbol de hasta 10–12 m de alto, con tronco de hasta 30 cm de diámetro; corteza delgada, gris, surcada; ramillas de 1.5–3 mm de grosor, café o café rojizas, con lenticelas prominentes, pubescentes a glabrescentes;

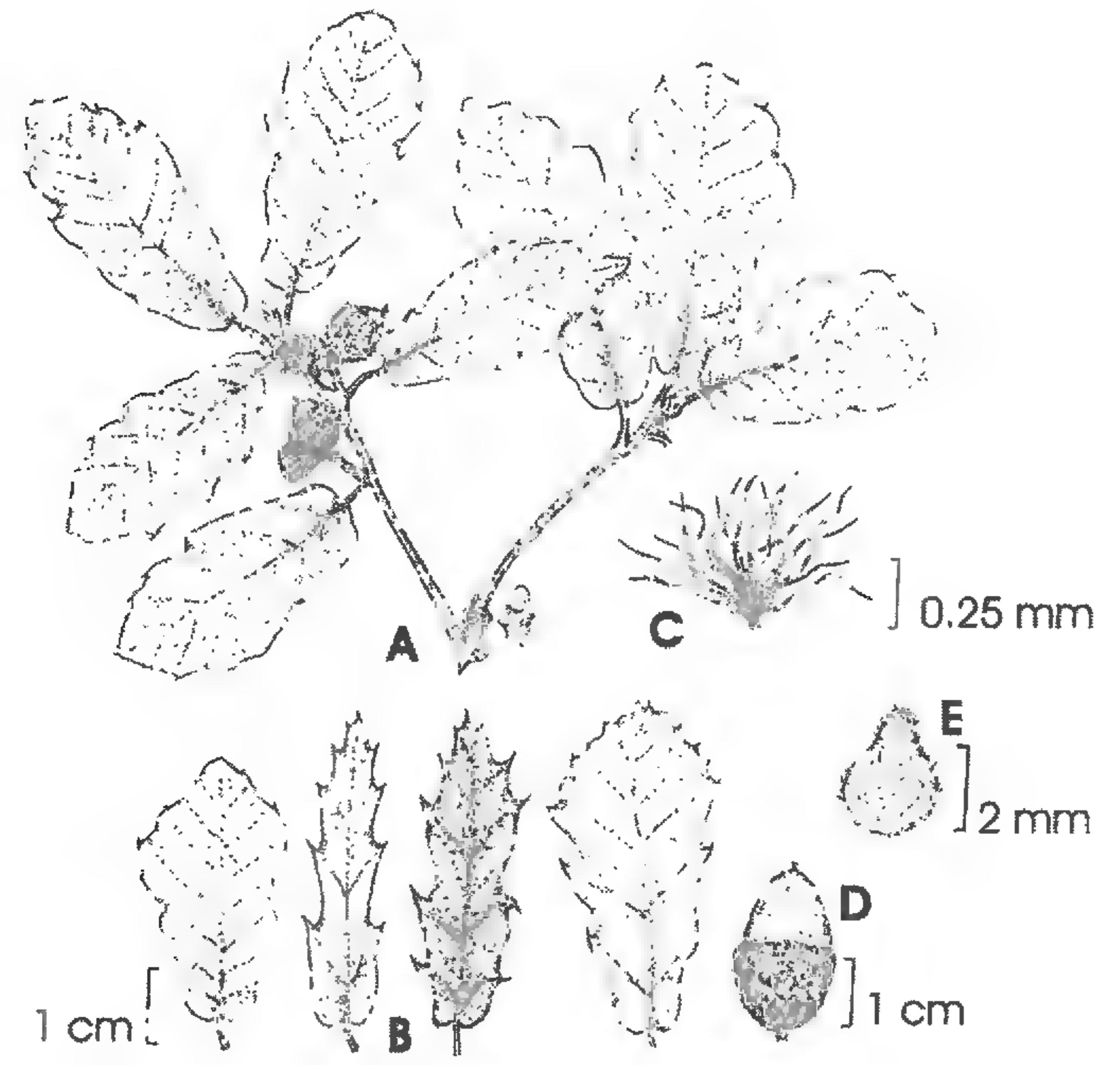

Fig. 29. ***Quercus sideroxyla*****. A,** rama con hojas y bellotas; **B,** variación en hoja; **C,** pelo fasciculado; **D,** bellota; **E,** escama de la cúpula.

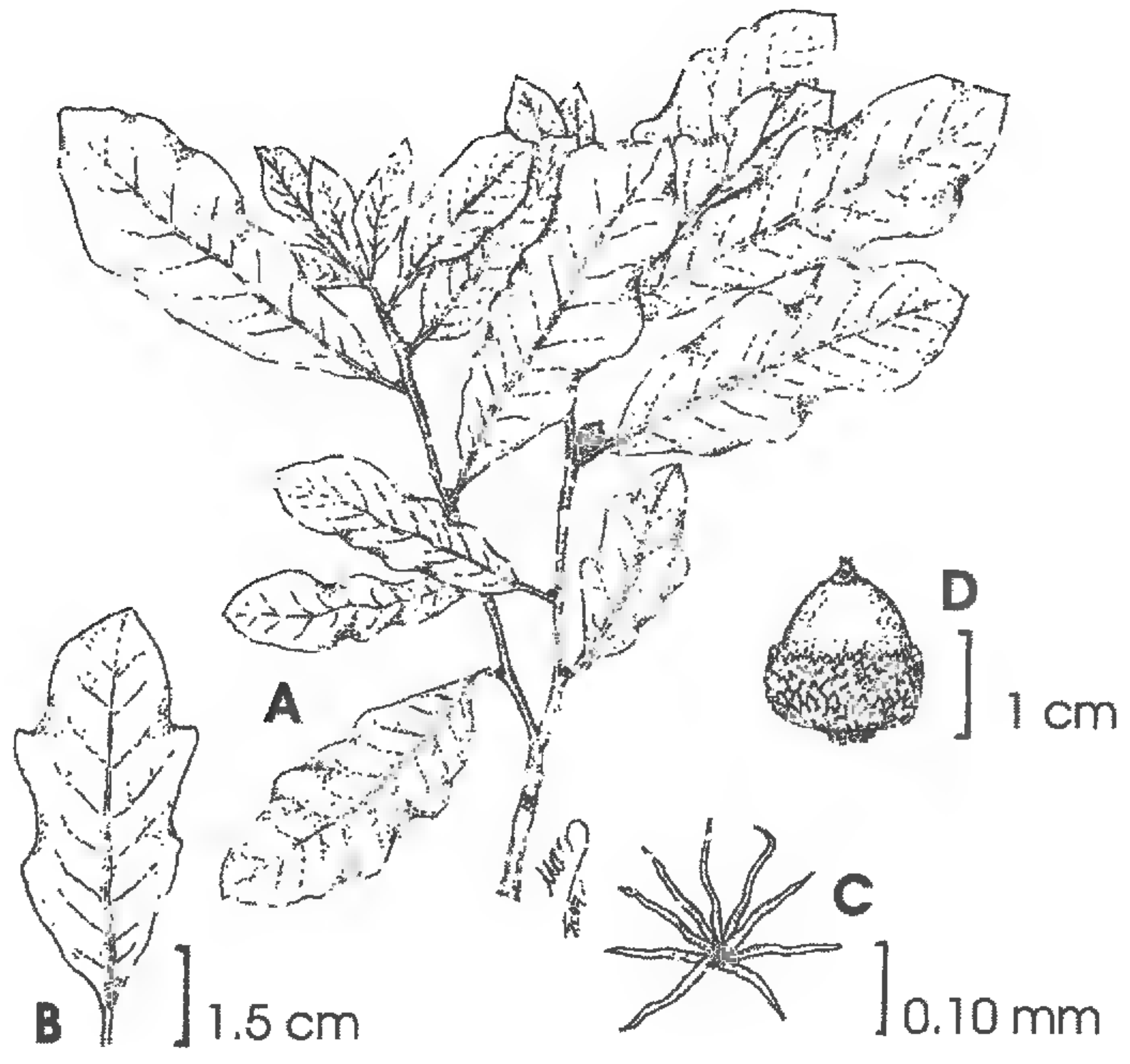

Fig. 30. ***Quercus sinuata*****. A,** rama con hojas; **B,** hoja; **C,** pelo fasciculado; **D,** bellota.

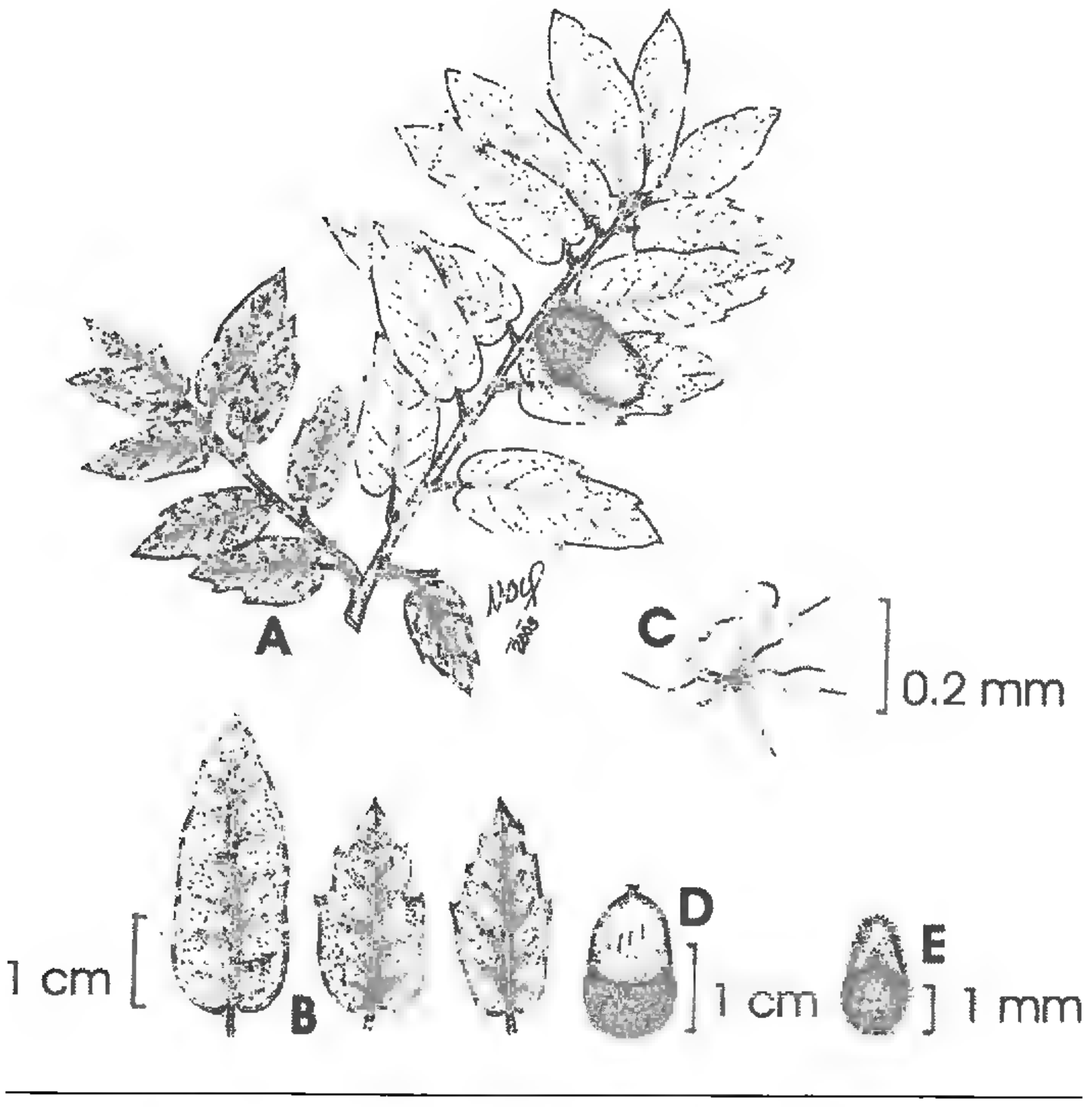

Fig. 31. ***Quercus striatula*****. A,** rama con hojas y bellota; **B,** variación de la hoja; **C,** pelo fasciculado; **D,** bellota; **E,** escama de la cúpula.

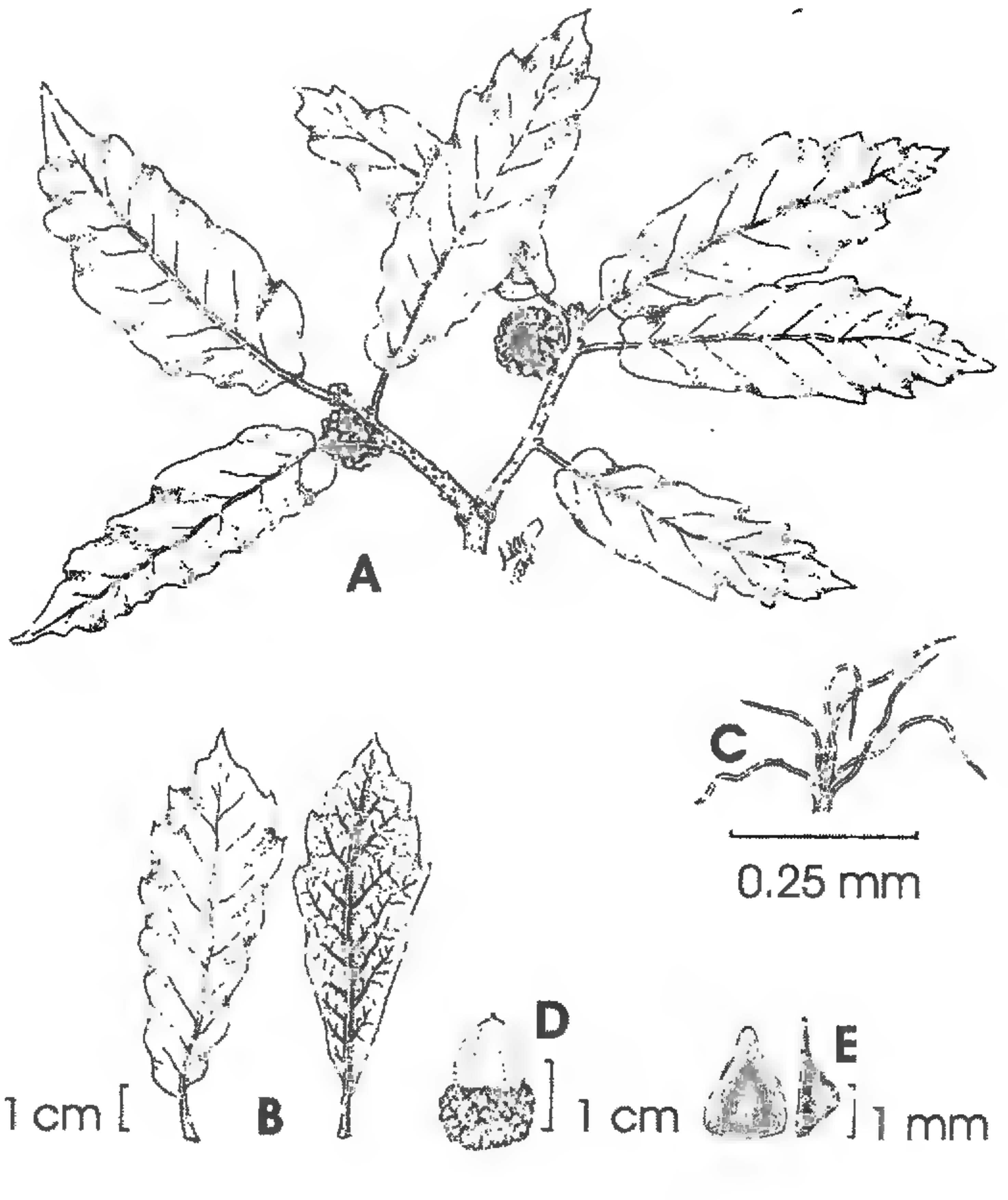

Fig. 32. ***Quercus tuberculata*****. A,** rama con hojas y bellotas; **B,** hoja por haz y envés; **C,** pelo fasciculado estipitado; **D,** bellota, **E,** escama de la cúpula, vista frontal y lateral.

yemas ovoides, obtusas o agudas, de 1–2(–3) mm de largo, glabras; estípulas subuladas de 4–6 mm de largo, pubescentes, persistentes solo en las yemas terminales. Hojas deciduas, coriáceas; pecíolos de 4–10(–20) mm de largo, rojizos cerca de la base, glabros o pubescentes; limbos oblongos, de elípticos a ovados u obovados, de (2–)8–12(–24) cm de largo y (1.5–)4–6(–12) cm de ancho, ápice obtuso a agudo, base cordada a redondeada, raras veces cuneada, margen ligeramente cartilaginoso, engrosado, entero o dentado en la porción distal de la hoja; haz verde lustroso, finamente reticulado, con el margen ondulado, glabro o con pelos fasciculados esparcidos, envés verde con tonos café amarillento, glabro o con indumento fasciculado estipitado, usualmente restringido a las nervaduras; nervaduras 8–10 en cada lado, un poco impresas en el haz, formando un retículo prominente en el envés, ramificadas y anastomosadas hacia el margen. Inflorescencias masculinas de 5–8 cm de largo. Inflorescencias femeninas de hasta 3 cm de largo con 2–3 flores sobre pedúnculos cortos. Fruto anual, solitario o en pares, subsésil o con pedúnculos cerca de 5 mm de largo, cúpula de 12–15(–20) mm ancho y 10–12 mm de alto, escamas engrosadas (tuberculadas) y con puberulencia canescente en la base, ápice café, delgado y glabro; nuez ovoide de 15–20(–25) mm de largo, con pelos diminutos, de pelos simples cerca del ápice o glabrescente.

Distribución.—Se distribuye en el noroeste de la República Mexicana, en los estados de Sonora, Chihuahua, Sinaloa y Durango, así como en Aguascalientes, Michoacán y Guanajuato llega hasta el este a la Sierra Madre Oriental en Nuevo León. En Coahuila se encuentra en el centro-este del estado solamente en la sierra La Gavia, particularmente en el cañón La Gavia y en la sierra Pajaros Azules, en bosque de encino, se asocia con *Quercus invaginata*, *Q. laceyi*, *Q. gravesii*, *Juglans mollis*, *J. microcarpa*, *Fraxinus greggii*, *Colubrina greggii*, *Rhus virens*, *Pistacia texana* y *Ungnadia speciosa*. Generalmente crece en altitudes entre 1400–2200 m, sobre laderas bajas y en fondo de cañones húmedos, con exposición norte o noroeste. Especie rara para el área del estado.

Notas.—Se reconoce por las hojas coriáceas, verde oscruro, brillantes, casi glabras, oblongas a obovadas, usualmente de menos de 12 cm de largo, margen entero a dentado, envés con pelos fasciculados en la nervadura media. Bellotas de 1.5–2.5 cm de largo, con escamas de la cúpula con base tuberculada.

Material examinado: **Mpio. Candela:** sierra Pajaros Azules, rancho Santa María, en los límites con Lampazos N. L., 795 m, 24 nov 2002, *J.J. Medellín V. 489* (CFNL).

GLOSARIO

Basado en Font Quer (1979) y Moreno (1984).

Acuminado Con márgenes rectos o convexos que terminan en ángulo menor de 45 grados

Afelpado Con pelos largos que forman una mata densa como de fieltro.

Amento Inflorescencia espigada, decidua, generalmente flexuosa, de florecitas pequeñas y unisexuales.

Ampuloso Con estructuras parecidas a ampulas o vejigas.

Anastomosado Caracterizado por tener dos o más nervios que se vuelven a unir.

Arista Estructura setosa, elongada y flexible, consistiendo de una vena desnuda cubierta por tejido corneo.

Bellota Aquenio agrandado o nuez, derivado de un ovario ínfero, rodeada por un involucro seco llamado cúpula.

Caedizo Miembro que se desprende tempranamente.

Canescente (canoso) Indumento que se vuelve blanco o blanco-grisáceo con el tiempo.

Castaño De color café-rojizo

Ciliado Con pelos marginales.

Conduplicado Doblado a lo largo del eje central o nervio medio, con el haz hacia adentro.

Coriáceo De consistencia similar al cuero.

Crenado Con dientes grandes y redondeados.

Crispado Con los márgenes divididos, levantados a intervalos.

Cúpula Es el conjunto de brácteas del involucro en forma de copa, rodeando el fruto o la flor femenina en encinos.

Esclerosado Endurecido, como de piedra.

Estípulas Apéndices laminares que se forman en número de dos a cada lado de la base foliar.

Filiforme De forma alargada y delgada.

Fimbriado Franjeado o con cilios gruesos y densos.

Glabro Sin ningún tipo de indumento, lampiño.

Glabrescente Que tiende a quedar glabro o casi sin vellos.

Glauco De color verde claro, con matiz ligeramente azulado.

Impreso Nervaduras marcadas en la superficie del haz.

Indumento Conjunto de pelos, glándulas, escamas, etc., que cubren la superficie de un órgano de la planta.

Involuto Con los márgenes enrollados sobre la superficie superior o ventral.

Lanoso Con pelos largos, suaves y entrecruzados semejantes a la lana.

Ligulado Con una estructura en forma de lígula sobre una parte abrazadora.

Lobado Dividido en porciones o segmentos redondeados, llamados lóbulos

Mucrón Punta pequeña, que se proyecta a partir de la nervadura, cubierta por tejido corneo.

Obovado De forma ovada, pero con el ápice más amplio que la base.

Ovado Con la base más amplia que el ápice.

Oblanceolado De forma lanceolada invertida (el ápice más ancho que la base).

Papiloso Con papilas (pequeños tubérculos unicelulares de forma más o menos cónica) en la superficie.

Pelos glandulares Glándula epidérmica peliforme. Pelo con una estructura globosa secretora en el ápice, puede ser unicelular o multicelular, peltado, pedúnculado o sésil.

Piloso Con pelos largos y suaves.

Puberulento Con pelos simples muy finos, cortos y escasos. Diminutamente pubescente.

Pubescente Con pelos simples y delgados, finos y rectos.

Pulverulento Con una cubierta de polvillo diminuto.

Repando Escasamente sinuado.

Revoluto Con los márgenes enrollados sobre la superficie inferior o dorsal.

Seríceo Con pelos largos y sedosos, generalmente adpresos.

Sinuado Con curvas largas perpendiculares, paralelas al eje central de la estructura; especialmente del margen.

Subulado Estrechado hacia el ápice hasta rematar en punta fina.

Tomento Conjunto de pelos largos y muy entrecruzados que cubren totalmente la superficie.

Tomentuloso Escasa o cortamente tomentoso, diminutamente tomentoso.

Tricoma Prominencia del tejido epidérmico, a menudo en forma de pelo.

Turbinado En forma de cono invertido, estrecho en la base y ancho en el ápice.

Velutino Cubierto por pelos densos, largos, suaves y rectos, como el terciopelo.

Velloso Con pelos largos y suaves curvados pero no afelpados.

Vermiforme Alargado, como en forma de gusano.

AGRADECIMIENTOS

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THOMAS WALTER TYPIFICATION PROJECT, VI: NEOTYPES FOR AN ADDITIONAL 18 WALTER NAMES

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ABSTRACT

Flora Caroliniana was published by Thomas Walter in 1788. Because of the early date of this flora, many of its species were new to science, and the names given them by Walter remain of importance in the American Southeast. Although Walter kept no herbarium, recent efforts have chosen later collections as replacement types. Here, a remaining number of these species are addressed, with selection of appropriate neotypes to represent an additional 18 Thomas Walter names.

RESUMEN

Flora Caroliniana fue publicada por Thomas Walter en 1788. Debido a la fecha antigua de esta flora, muchas de estas especies fueron nuevas a la ciencia, y los nombres dados por Walter siguen teniendo importancia en el Sureste de América. Aunque Walter no dejó un herbario, esfuerzos recientes han escogido colecciones más nuevas como tipos de reemplazo. Aquí se tratan las restantes de estas especies con una selección de neotipos apropiados para representar 18 nombres adicionales de Thomas Walter.

In the 1780s, Thomas Walter (1740–1789) owned and operated a rice plantation on the Santee River, Berkeley County, South Carolina. His interest in the plants of the area led him to compile a simple flora in which he gave them descriptions and Latin names. This book, *Flora Caroliniana* (1788), is the first treatment of American plants employing the binomial nomenclature and sexual classification system of Linnaeus. Of even greater importance, the early date of this publication has given many of his names priority over those of later authors.

This paper largely completes typification of the plant names published by Walter in his pioneer *Flora*. By the selection of type specimens to represent these names, they become fixed in their meaning, bringing stability to the nomenclature of this portion of the Southeastern flora.

Walter kept no herbarium (Ward 2007a). In the absence of authentic original materials, the International Code of Botanical Nomenclature (McNeill et al. 2006) permits selection of another specimen—a neotype—to represent the missing type.

The Thomas Walter Typification Project (Ward 2006a, 2007b, 2007c, 2007d, 2008) and ancillary studies (Ward 2006b, 2007e, 2007f, 2007g) have addressed the typification of many of the names assigned to American plants by Walter. These studies also treat aspects of the relationship between Walter and the Scottish horticulturist John Fraser. Fraser's herbarium (the Fraser/Walter herbarium, BM), gathered in the Carolinas and Georgia in 1787, was briefly seen by Walter, but is largely irrelevant to typification of Walter's names. Selection of collections made by other persons is the only pathway to stability of the great majority of Walter's names.

In previous numbers of the Project (2007d, 2008), the Harvard University Herbaria (GH) were the source of selected specimens. Here, for those species not adequately represented in the holdings of that institution, the herbaria of the University of South Carolina (USCH) and Duke University (DUKE) have provided specimens of quality appropriate for selection as neotypes.

With inclusion of the species treated here, essentially all of Walter's names that are in common use have now been assigned types, as have an appreciable number of Walter's names usually referred to synonymy. Still other of his names that have been treated as synonyms, or are unidentified as to their modern meaning, remain unaddressed. A subsequent number of the Project, now in preparation, will provide an index to typification or other disposition of all Thomas Walter names.

J. Bot. Res. Inst. Texas 2(2): 1279 – 1283. 2008

An additional 18 of Walter's species are here assigned neotypes. Specimen citations, if not otherwise attributed, are to the Fraser/Walter herbarium (BM) as described elsewhere (Ward 2006a). The typifications are presented in the format employed previously, in alphabetical sequence, using the names given them by Thomas Walter.

TYPIFICATIONS

WALTER'S NAME: *Amsonia Tabernaemontana* Walter (p. 98)
MODERN NAME: **Amsonia tabernaemontana** Walt.
Typical *Amsonia tabernaemontana*, with ovate leaves, is rare in eastern SC, frequent westward. The narrow-leaved var. *salicifolia* (Pursh) Woodson is frequent on the SC coastal plain. Walter described his plant with leaves "*ovatis*." Spm. 5-C, labeled "*Amsonia Tabernaemontana*" by Fraser, has the broader leaves of the typical variety; there is no evidence it was seen by Walter. Though the ovate-leaved form may not have been the variation most familiar to Walter, to preserve accepted usage (Woodson 1928: 406) a wide-leaved specimen, *Smith 1114*, 3 June 1941 - USCH, from Witherspoon Island, Darlington County, South Carolina, is here selected as NEOTYPE for *Amsonia tabernaemontana* Walt. It has been suggested that Walter's name must have been taken from *Tabernaemontana amsonia* L. (1762) and that Walter's type must therefore be the same as Linnaeus (J.S. Pringle, pers. comm., Dec 2005). In such case, Walter's name would be superfluous and thus illegitimate. Selection of a Walter neotype leaves the suggestion in the realm of conjecture.

WALTER'S NAME: *Anemone caroliniana* Walter (p. 157)
MODERN NAME: **Anemone caroliniana** Walt.
Very rare in SC (3 counties, all inland), rare also in central GA. This distant range indicates the species was probably brought to Walter by John Fraser. There is no specimen in the Fraser/Walter herbarium (BM). *Pyron 2109*, 19 Mar 1938 - DUKE (annot. Carl S. Keener 1980), from 3 mi. SW of Irwinville, Irwin County, Georgia, is here selected as NEOTYPE for *Anemone caroliniana* Walt.

WALTER'S NAME: *Arethusa spicata* Walter (p. 222)
MODERN NAME: **Hexalectris spicata** (Walt.) Barnhart
Infrequent throughout. Blake (1915: 136) has stated Walter's diagnosis is "quite distinctive" of this species. There is no specimen. *Evett s.n.*, 9 July 2000 - USCH (annot. John Nelson 2000), from Rucker Road, Chapin, Richland County, South Carolina, is here selected as NEOTYPE for *Arethusa spicata* Walt., basionym of *Hexalectris spicata* (Walt.) Barnhart.

WALTER'S NAME: *Athanasia paniculata* Walter (p. 201)
MODERN NAME: **Verbesina walteri** Shinners [= *Ridan paniculata* (Walt.) Small]
Verbesina walteri is rare in SC, known only from three counties. Walter's epithet is not transferrable to *Verbesina* (not *V. paniculata* Poir., 1808). Shinners (1964) formed a new name, basing it upon Walter's name and description. No specimen has been identified in the Fraser/Walter herbarium (BM). The species is infrequent through much of its range, west to Texas. Available material, though from far beyond the reach of either Walter or Fraser, is believed representative of plants Walter might have known. *Thieret 24848*, 27 Sep 1966 - DUKE (annot. James R. Coleman 1969), from 8 mi. SE of Denham Springs, Livingston Parish, Louisiana, is here selected as NEOTYPE for *Athanasia paniculata* Walt., the basis for *Verbesina walteri* Shinners.

WALTER'S NAME: *Frasera caroliniensis* Walter (p. 88)
MODERN NAME: **Swertia caroliniensis** (Walt.) Kuntze
Very rare (3 counties in SC.: Abbeville, Greenwood, Laurens, all on piedmont); undoubtedly a Fraser discovery. A supposed specimen (48-B), labeled "*Frasera Caroliniensis*" by Fraser, has since been identified as *Dodecatheon meadia* (Britten 1921: 70). *Horn 6581*, 8 May 1993 - USCH, from Sumter National Forest, ca. 11 mi. NE of Clinton, Laurens County, South Carolina, is here selected as NEOTYPE for *Frasera caroliniensis* Walt., basionym of *Swertia caroliniensis* (Walt.) Kuntze.

Walter's name: *Hydrolea quadrivalvis* Walter (p. 110)
Modern name: **Hydrolea quadrivalvis** Walt.
Frequent in eastern SC. No specimen has been identified. *Horn 4246*, 30 July 1990 - USCH, from just N of Laurel Hill Plantation, 2 mi. SE of Goose Creek, Berkeley County, South Carolina, is here selected as neotype for *Hydrolea quadrivalvis* Walt.

Walter's name: *Hypericum tubulosum* Walter (p. 191)
Modern name: **Triadenum tubulosum** (Walt.) Gleason
Very rare in SC (2 counties, both inland from Walter's Berkeley Co.); rare in central GA; not known in NC. But Walter's description seems unambiguous, clearly contrasted with *T. virginicum* and *T. walteri*. This probably is a Fraser discovery, perhaps obtained on his trip to the Flint River, west-central GA, in spring of 1787. There is no specimen. *Allison 10271*, 16 Oct 1997 - DUKE, from NE corner of Ft. Benning Military Reservation, 17.5 mi. NE of Cusseta, Chattahoochee County, Georgia, is here selected as neotype of *Hypericum tubulosum* Walt., basionym of *Triadenum tubulosum* (Walt.) Gleason.

Walter's name: *Iris hexagona* Walter (p. 66)
Modern name: **Iris hexagona** Walt.
Very rare in SC (known only in Charleston Co.). There is no specimen. *Hutto s.n.*, 4 June 1993 - USCH, from branch of Wambah Creek, Hampton Plantation State Park, Charleston County, South Carolina, is here selected as neotype for *Iris hexagona* Walt.

Walter's name: *Laurus melissaefolia* Walter (p. 134)
Modern name: **Lindera melissifolia** (Walt.) Bloom
Rare; in SC known only in 3 counties (Berkeley, Colleton, Darlington). Spm. 63-C was named "*Laurus melissaefolium*" by Walter and later annotated "*Benzoin melissaefolium*" by A. J. Kosterman. Its leaves are smaller than other specimens of that species. Spm. 63-H is similar, but was annotated by Kosterman as "*Benzoin odoriferum*," a synonym of *L. benzoin* (L.) Blume, which it could well be. An independent specimen of certain identity, *Williamson 1550*, 23 July 1961 - USCH, from 1 mi. NE of Honey Hill, Darlington County, South Carolina, is here selected as neotype for *Laurus melissaefolia* Walt., basionym of *Lindera melissifolia* (Walt.) Bloom.

Walter's name: *Melanthium hybridum* Walter (p. 125)
Modern name: **Melanthium hybridum** Walt. [= *Veratrum latifolium* (Desr.) Zomlefer]
Rare in SC, frequent in western NC; likely a Fraser discovery. No specimen has been identified. *Nelson 8431*, 12 Sept 1989 (2 sheets) - USCH (annot. D. E. Kennemore), from W of Marietta, Greenville County, South Carolina, is here selected as neotype for *Melanthium hybridum* Walt.

Walter's name: *Melanthium racemosum ?* Walter (p. 126)
Modern name: **Tofieldia racemosa** (Walt.) BSP.
Frequent in eastern SC. Walter was the first to form the combination *Melanthium racemosum*. [Others: *M. racemosum* Michx., 1803 (= *M. virginicum*), and *M. racemosum* Roth, 1821 (= *Iphigenia indica*).] His expression of doubt does not invalidate his name (Art. 34.1). No specimen has been identified. *Pittman & Darr s.n.*, 1 July 1999 - USCH, from Shirley tract, Lynchburg-Savanna area, near SC 327, Lee County, South Carolina, is here selected as neotype for *Melanthium racemosum* Walt., basionym of *Tofieldia racemosa* (Walt.) BSP.

Walter's name: *Ophioglossum crotalophoroides* Walter (p. 256)
Modern name: **Ophioglossum crotalophoroides** Walt.
Very rare in SC (two counties, one of which is Berkeley). There is no specimen. *Douglas s.n.*, 12 March 1991 - USCH, from along Simons Road, 1/2 mi. SW of SC 68, just W of Yemassee, Hampton County, South Carolina, is here selected as neotype for *Ophioglossum crotalophoroides* Walt.

Walter's name: *Pharnaceum maritimum* Walter (p. 117)
Modern name: **Sesuvium maritimum** (Walt.) BSP.
Infrequent along SC shore. No specimen. *Nelson 5850*, 28 July 1987 - USCH, from South Island, Yawkey Wildlife Center, Georgetown County, South Carolina, is here selected as NEOTPE for *Pharnaceum maritimum* Walt., basionym of *Sesuvium maritimum* (Walt.) BSP.

Walter's name: *Rajania ovata* Walter (p. 247)
Modern name: **Brunnichia ovata** (Walt.) Shinners [= *Brunnichia cirrhosa* Banks ex Gaert.]
Rare in the Carolinas, but known from three coastal SC counties (Charleston, Georgetown, Jasper). Shinners (1967) accepted Walter's description as applying to the plant also known as *Brunnichia cirrhosa*. Spm. 91-A, marked by Walter as "*Rajania (monoica)*" and noted by Fraser to be the "*ovata*" of the *Flora*, is a worthless scrap. *Aulbach-Smith 3144*, 15 July 1984 - USCH, from near Forks Lake Bluff, ca. 5 mi. NW of Hardeeville, Jasper County, South Carolina is here selected as neotype for *Rajania ovata* Walt., basionym of *Brunnichia ovata* (Walt.) Shinners.

Walter's name: *Silphium scabrum* Walter (p. 217)
Modern name: **Silphium scabrum** Walt. [= *Silphium dentatum* Ell.]
Common throughout. *Silphium asteriscus* L. is a more scabrous plant, but is essentially absent from SC. Guy Nesom (pers. comm., Aug 2007) has identified Walter's name as *S. dentatum*. Spm. 98-C was labeled "*Silphium*" by Walter and "*Scabrum*" by Fraser; it is a fragment without meaningful characters. *Nelson 5571*, 9 June 1987 (2 sheets) - USCH (annot. J. A. Clevinger 1999), from West Springs, Union County, South Carolina, is here selected as neotype for *Silphium scabrum* Walt.

Walter's name: *Sophora lanceolata* Walter (p. 135)
Modern name: **Baptisia lanceolata** (Walt.) Ell.
Rare in SC sandhills; perhaps a Fraser discovery. There is no specimen. *Stanford 16*, 4 April 1993 - USCH, from Compartment 84, Savannah River site, Barnwell County, South Carolina, is here selected as neotype for *Sophora lanceolata* Walt., basionym of *Baptisia lanceolata* (Walt.) Ell.

Walter's name: *Thymbra caroliniana* Walter (p. 162)
Modern name: **Macbridea caroliniana** (Walt.) Blake
Infrequent in eastern SC. Blake (1915: 132) noted Walter's description to be "definitive." No specimen has been identified. *Horn 2362*, 28 Aug 1987 - USCH, from Shaws Creek, 4 mi. N of Aiken, Aiken County, South Carolina, is here selected as neotype for *Thymbra caroliniana* Walt., basionym of *Macbridea caroliniana* (Walt.) Blake.

Walter's name: *Utricularia fibrosa* Walter (p. 64)
Modern name: **Utricularia fibrosa** Walt. [= *Utricularia striata* LeConte ex Torr.]
Rare on SC coastal plain, frequent in piedmont. There is no specimen. *Utricularia fibrosa* Walt. was left in limbo by Taylor (1989: 586) who determined Walter's plant was either *U. biflora* Lam. (1791) or *U. striata* LeConte ex Torr. (1819), but then rejected both. *Nelson 12474*, 18 May 1992 - USCH, from Training Area 25D, Fort Jackson, Richland County, South Carolina, a plant identifiable also as *U. striata*, is here selected as neotype for *Utricularia fibrosa* Walt.

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BOOK REVIEW

JACKIE M. POOLE, WILLIAM R. CARR, DANA M. PRICE, AND JASON R. SINGHURST. 2007. **Rare Plants of Texas: A Field Guide.** (ISBN-13: 978-1585445578, ISBN-10: 1585445576, pbk.). Texas A&M University Press, Lewis Street, 4354 Texas A&M University, College Station, Texas 77843-4354, U.S.A. (**Orders:** www.tamu.edu/upress, 800-826-8911). $35.00, 656 pp., color photographs and maps, drawings, 5 3/4" × 9 1/4".

Texas Parks and Wildlife Department botanists, Jackie M. Poole and David H. Riskind, published their first report in 1987 about Texas' endangered or threatened plants. That listing included only 21 species. The authors began work on the new book in 2000. Over 200 species are identified and described as endangered, imperiled, or declining in the *Rare Plants of Texas*. Because most of these plants are too rare to be mentioned, much less pictured, in standard field guides, only a handful of botanists have known what these plants look like in their natural habitats.

Complete with photographs, line drawings, and county maps, this book describes the officially listed candidate and species-of-concern plants in Texas. Individual accounts include information on distribution, habitat, physical description, flowering time, federal and state status, similar species, and published references. The authors also provide brief introductory chapters on the state's vegetation regions; the history of plant conservation in Texas; federal, state, and other ranking methods; threats to native plants; recovery methods; and reporting guidelines.

This reference guide is a comprehensive and detailed look at the rare plants of Texas. The book will be primarily of interest for botanists and those laypersons seriously involved with the subject matter. Highly technical in nature and written in a dry academic tone, the excellent *Rare Plants of Texas* will not appeal to everyone. And it is not intended for a general interest audience but rather for agency personnel, non-governmental entities, environmental consultants, natural resource professionals, naturalists, academics, and anyone who needs to know about the listed, candidate, or species of concern plants of Texas.

After a brief preface and an acknowledgment section, there is a section on the various natural (vegetation) regions of Texas. This section goes into detail about the land mass and various types of plants typically found in the 11 regions, illustrated by a colored map of the natural regions of Texas. It is noted here that rare species are still being found today in Texas as much of the state has not been surveyed in the manner required to note and document everything.

Sections on the history of plant conservation, on the law and terms being used, and on the threats to rare plants which are primarily human-related are followed by the section on natural regions. This is followed by sections on "Management and Restoration of Rare Plants" and "Nomenclature and Species Selection." A copy of the official "Wildlife Diversity Reporting Form" issued by the Texas Parks and Wildlife Department to report a rare plant, animal or habitat, is also included, along with instructions for its use.

"Species Treatments" is the core section of the book. Each plant is depicted in a drawing, a color picture, and a location on a county map of Texas. Each plant has listed its scientific name, common name, family name, endangered status date, where it lives, and a detailed description of the plant, habitat of the plant, and comments and references on the plant. Listed in alphabetical order, each plant is detailed across two pages and depicted in multiple color photographs and ink drawings. Overall, 232 species of plants are illustrated with 247 color photographs, 234 color distribution maps, and 215 superbly rendered line drawings by artist Linny Heagy, who has been associated with the project since its inception in 2000.

Following the species treatments is a short section on what was excluded from this book and why. A very detailed glossary of terms, a 79-page reference section, and an extensive index of thirteen pages concludes this field guide.

Up until the last few decades, relatively little was known about most of the state's plant species in dangerous decline, thus making conservation action decisions difficult. Now every Texan has the opportunity to take the first step by recognizing exactly what we are in danger of losing.

This is a comprehensive book and is a well done reference guide that should be of interest to the professional as well as the general layman interested in the field. Those with a deep interest in the topic will appreciate it the most. For the readership it was designed for, it works well and provides a glimpse of the many rare plants found across the great state of Texas. The decision to use a flex binding, enabling readers to easily scan both pages devoted to each species without fear of damaging the binding, is heartily applauded by this reviewer.

"*Rare Plants of Texas* is a major contribution to knowledge about Texas plants. The detailed information about specific rare plants, excellent line drawings, and extensive photographs make this book indispensable to anyone wishing to learn about the numerous rare plants in the state," said George M. Diggs Jr., Ph.D., an Austin College professor of biology. "Further, anyone generally interested in Texas botany or conservation will find the carefully done introduction extremely valuable, with topics ranging from the natural regions of Texas to the history of plant conservation in the state."—*Gary L. Jennings, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

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CARYOPHYLLACEAE IN NORTH AMERICA: CHANGE OVER THE LAST 110 YEARS

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ABSTRACT

We compare the treatment of the Caryophyllaceae in *Flora of North America* (Rabeler & Hartman 2005), with that in the *Synoptical Flora of North America* (Robinson 1897), summarizing additions in native and introduced species by subfamily, genus, and location of discovery or where first noted.

RESUMEN

Comparamos el tratamiento de las Caryophyllaceae en la *Flora of North America* (Rabeler & Hartman 2005), con el de la *Synoptical Flora of North America* (Robinson 1897), resumiendo adiciones en las especies autóctonas e introducidas por subfamilia, género, y localización del descubrimiento o donde fue encontrada por primera vez.

Publication of the Caryophyllaceae in *Flora of North America* [FNA] (Rabeler & Hartman 2005) presented the opportunity to compare those results with previous efforts. Our treatment is the first to include all taxa accepted for North America north of Mexico since that by B.L. Robinson (1897) in *Synoptical Flora of North America*.

The family treatment for FNA was the combined effort of ten authors, two of whom also served as editors. Four subfamilies were recognized in which 286 species and 54 infraspecific taxa belonging to 37 genera were treated in 212 pages of illustrated text.

By contrast, the Caryophyllaceae in *Synoptical Flora of North America* was published solely by B.L. Robinson. It first appeared as two papers (Robinson 1893, 1894) "preliminary to [the] treatment" in the Flora and then in the second fascicle of the *Synoptical Flora* (Robinson 1897). Three subfamilies containing 167 species and 53 infraspecific taxa belonging to 19 genera were treated in 48 pages sans illustrations. The Illecebraceae (Paronychioideae) were placed far from the Caryophyllaceae, following G. Bentham and J.D. Hooker's (1862–1883) classification, and apparently were never published. Based on members of this subfamily that were known by 1890, we estimate that 7 genera, 24 species, and 1 infraspecific taxon would have been included in the Paronychioideae (and the tallies for the Caryophyllaceae), expanding the treatment by several pages (Table 1).

The Caryophyllaceae worldwide contain about 3000 species in 83 (*Silene* s.l.) or 89 (*Silene* s.s.) genera (Rabeler & Hartman 2005). We followed a four-subfamily classification which emphasizes morphological features but is yet to be adequately tested by molecular analyses. The four subfamilies are: Alsinoideae (30 genera, 1040 species), Caryophylloideae (26 [20] genera, 1500 species), Paronychioideae (17 genera, 200 species), and Polycarpoideae (16 genera, 210 species). The most commonly cited classification (Bittrich 1993) includes three subfamilies, treating the Polycarpoideae as a tribe within the Paronychioideae. Preliminary evidence indicates that the Alsinoideae and the Caryophylloideae form a monophyletic group within the family separate from members of the other two subfamilies (Nepokroeff et al. 2002; Fior et al. 2006).

The balance of this paper will compare the two treatments of Caryophyllaceae of North America (Rabeler & Hartman 2005 and Robinson 1897) by subfamily and summarize the increases in both native and alien members. Our analyses take into account differences in taxonomic rank, although subspecies and varieties are combined under the collective term, infraspecific taxa.

J. Bot. Res. Inst. Texas 2(2): 1285 – 1289. 2008

TABLE 1. A comparison of the number of genera (g), species (sp), and infraspecific taxa (infra) by subfamily as found in the two taxonomic treatments of the Caryophyllaceae.

Subfamily	Robinson 1894, 1897	Rabeler & Hartman 2005
Alsinoideae	5 g/ 77 sp + 28 infra	16 g/ 137 sp + 32 infra
Caryophylloideae	8 g/ 68 sp + 19 infra	8 g/ 89 sp + 14 infra
Paronychioideae	7 g/ 24 sp + 1 infra*	6 g/ 32 sp + 4 infra
Polycarpoideae	6 g/ 22 sp + 5 infra	7 g/ 28 sp + 4 infra
*projected tally – see text		

At the subfamily level, most of the differences involve the Alsinoideae (Table 1). Changes within this subfamily (stipules absent; sepals not awned, free or only basally connate; petals usually present; fruits capsules) encompass most of the new generic alignments and new species, both native and introduced. Robinson followed a broad concept for *Arenaria* and *Stellaria*. The narrower concepts we employ recognized six genera (*Arenaria, Eremogone, Honckenya, Lepyrodictlis, Minuartia,* and *Wilhelmsia*) in the former genus and three (*Myosoton, Pseudostellaria,* and *Stellaria*) in the latter.

By contrast, the Caryophylloideae (stipules absent; sepals not awned, fused basally into a cup or tube; petals present, often conspicuous; fruits capsules) treatment deviated the least. The major differences are Robinson's segregation of *Lychnis* from *Silene* (Morton 2005b preferred a more inclusive circumscription) and the addition of 10 new native species of *Silene*.

The differences in the Paronychioideae (stipules present; sepals often awned, distinct or scarsely fused; petals absent; fruits utricles) treatments involve the addition of ten new taxa of *Paronychia* and the transfer of *Scleranthus* to the Alsinoideae.

Within the Polycarpoideae (stipules present; sepals rarely awned, distinct or scarsely fused; petals absent or often present; fruits capsules), major changes involve the addition of the genus *Polycarpaea*, two new alien species of *Spergula*, and five additional species of *Drymaria*.

The net change in the number of taxa between the two treatments is shown in Table 2. As noted above, the increase in the number of genera (26 to 37) mostly reflects differences in generic concepts. Change in the number of species (185 to 286) suggests that the number of species has increased by 50 percent; this is somewhat inflated since some of Robinson's infraspecific taxa are now treated as species (e.g., in *Cerastium*). The very similar numbers of infraspecific taxa (53 vs. 54) is somewhat deceiving. Besides elevation of some taxa to the species level, others are no longer recognized (e.g., the five varieties of *Silene douglasii* that Robinson recognized). On the other hand, 22 varieties and subspecies in the FNA treatment have been described since 1894. Given these caveats, the total taxa comparison (species + infraspecific taxa excluding autonyms), although increasing by about 40 percent since 1894, probably underestimates the actual change.

CHANGES INVOLVING NATIVE TAXA

Since the beginning of North American botany, most floristic attention has been on collecting and identifying our native flora. The distribution of new native species by genus is shown in Table 3. One native genus (*Geocarpon* in 1914) and 49 native species have been described since 1894. Not only are 63 percent of these species in the Alsinoideae, but 45 percent are within *Arenaria* s.l.

The majority of the new native species were first discovered in the western United States; not entirely unexpected given that, prior to 1890, much of the West was poorly known botanically. In descending order, California (12), the southwest United States (10), Texas (8), Alaska (4), and the Pacific Northwest (3) account for 37 of the 49 species. The remaining 12 initially were discovered in northeastern North America (5), southeastern United States (3), Russia (2) and the central United States (2).

CHANGES INVOLVING INTRODUCED TAXA

Efforts to document our alien (introduced or exotic) flora more precisely than "occurring as a weed here and there" (*Gypsophila muralis* L., Gleason and Cronquist 1991) have increased in recent decades. Rabeler has

Table 2. The number of genera, species, and infraspecific taxa (excluding automatically created taxa) recognized in each of the two treatments. These figures are followed by the percent increase, respectively.

	Robinson	Rabeler & Hartman	% increase
Genera	26	37	42
Species	191	286	50
Infraspecific	53	54	1
Total taxa	244	340	39

Table 3. The numbers of new native species for North America by subfamily and genus.

Alsinoideae (31): Arenaria (4), Cerastium (5), Eremogone (5), Geocarpon (1), Minuartia (11), Pseudostellaria (2), Stellaria (3)
Caryophylloideae (10): Silene (10)
Paronychioideae (5): Paronychia (5)
Polycarpoideae (3): Drymaria (2), Spergularia (1)

been involved in reporting new introductions of species and distribution records for Caryophyllaceae over the past 29 years (Rabeler 1980). Likewise, botanists at the Rocky Mountain Herbarium (see Hartman and Nelson 2008) have made a concerted effort to document invasives during more than 54 major inventories throughout the Rocky Mountains (over 840,000 new numbered collections since 1978, both native and introduced) These initiatives long preceded the recent piqued interest in exotics. Alien taxa are very important in the Caryophyllaceae. Of the 37 genera in the 2005 treatment, all members of 15 of those genera (41%) are introduced to North America; this includes six of the eight genera in Caryophylloideae.

The distribution of new introduced species by genus is shown in Table 4. Three genera (*Polycarpaea, Lepyrodiclis, Moenchia*) did not appear in Robinson (1897) despite *Moenchia erecta* (L.) G. Gaertn., B. Mey. & Scherb.having been collected near Baltimore and Philadelphia in the 1830s (Rabeler 1991). Thirty species, one-half of them members of the Alsinoideae, were first reported since 1897; seven of these were documented in North America subsequent to 1960.

Knowing when and where an introduction first arrived in North America is nearly impossible unless it was introduced intentionally. For example, *Petrorhagia prolifera* (L.) P.W. Ball and Heywood was brought to North America around 1800 and appeared in John Bartram's garden in Philadelphia (Rabeler 1985). Of course, the actual documentation of the plant may be long after its introduction.

Where documented, the first collections of "new" introductions were chiefly from coastal states, especially port areas. They include the southeastern United States and Texas (8), California (6), the Pacific Northwest (6), and northeastern North America (4). Only three species appear to have been gathered first in an inland state or province (*Moehringia triphylla* (L.) Clairv. in Ohio, *Cerastium diffusum* Pers. in Missouri, and *Silene sibirica* (L.) Pers. in Saskatchewan).

Some recently discovered aliens, especially those first collected in the southeastern United States, have become widespread in eastern North America (e.g., *Stellaria pallida* (Dumort.) Crépin, *Cerastium pumilum* Curtis, and *C. brachypetalum* Pers. Of the aliens included in Robinson (1897), some have become widespread. *Gypsophila paniculata* L. noted as "doubtful in Manitoba" now is a noxious weed there as well as in California and Washington (Rice 1997 onwards). *Holosteum umbellatum* L., in Robinson's time known only around Philadelphia, Pennsylvania, is now documented from 41 states or provinces (see esp. Shinners 1965).

The occurrence of two alien species has diminished sharply. *Agrostemma githago* L. and *Vaccaria hispanica* (Mill.) Rauschert were formerly very common in wheat fields. As agricultural practices advanced, seed purity increased and transport of propagules of these species declined. In both cases, the range maps in the FNA treatments (Thieret 2005; Thieret and Rabeler 2005) are probably best described as historical

Table 4. The numbers of new introduced species for North America by subfamily and genus.

Alsinoideae (15): Cerastium (6), Lepyrodiclis (1), Moehringia (1), Moenchia (1), Sagina (2), Stellaria (4)
Caryophylloideae (14): Dianthus (2), Gypsophila (2), Petrorhagia (2), Saponaria (1), Silene (7)
Paronychioideae (4?): Paronychia (2), Herniaria (1), Scleranthus (1?)
Polycarpoideae (6): Drymaria (1), Polycarpaea (1), Spergula (2), Spergularia(2)

maximal distributions. While very few recent collections were seen during the preparation of those treatments, *Agrostemma githago* remains on the noxious weeds lists of 13 states or provinces (Rice 1997 onwards).

WHAT MIGHT THE FUTURE HOLD?

We believe that there are additional native Caryophyllaceae yet to be described in North America. Nineteen of the 286 species in the FNA treatment were described since 1960. Two additional species have been described, both from California, since the 2005 treatment; *Silene salmonacea* T.W. Nelson, J.P. Nelson and S.A. Erwin (Nelson et al. 2006) and *Eremogone cliftonii* Rabeler and R.L. Hartman (Rabeler & Hartman 2008).

Likewise, the number of exotics are bound to increase. With seven species in the 2005 treatment first reported since 1960, it seems likely that as botanists take our dynamic alien flora more seriously, the tally will rise.

In addition to new discoveries and distributional records, additional study of the relationships of the taxa likely will change the treatment of the Caryophyllaceae. Many such questions are discussed in the FNA treatment (Rabeler & Hartman 2005) and could form the basis of interesting studies. As examples, do *Stellaria dicranoides* and *Stellaria fontinalis* really belong in other genera (Morton 2005a) and should *Silene* and/or *Minuartia* be treated as multiple genera as discussed by Morton (2005b) and Rabeler et al. (2005) respectively.

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BOOK REVIEW

Joe C. Truett. 1996. **Circling Back: Chronicle of a Texas River Valley.** (ISBN 0877455317, pbk.). University of Iowa Press, 119 West Park Road, 100 Kuhl House, Iowa City, Iowa 52242-1000, U.S.A. (**Orders:** www.uiowapress.org, 800-621-2736, 800-621-8476 fax). $19.95, 230 pp., photographs, 6" × 9".

Back home for the funeral of his grandfather in 1967, Joe C. Truett thought long and hard about the world of the Angelina River valley in East Texas that Corbett Graham had known and he himself had glimpsed. His vision resulted in this portrait of a place over time, its layers revealed by his love and care and curiosity. He celebrates his family's heritage and the unspoiled natural world of the Piney Woods without nostalgia.

The change in his valley led to him selecting a career in biology and to a desire to slow or prevent the kinds of environmental changes that he had witnessed. Much of his early career focused on research aimed at predicting and helping to alleviate adverse effects of man's activities on fish, wildlife, and habitats. Disillusionment built over time as he observed the ineffectiveness of conventional channels in preventing environmental degradation. He began to look for other channels that would be more effective. *Land of Bears and Honey* was one result of that search and *Circling Back* is a continuation of that search.

Part of the American Land and Life series, this book is well-thought out, lucid, and should be included in any public or college library. It includes a bibliography and thoughtfully selected illustrations.—*Gary L. Jennings, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

THE BIG THICKET: PRISTINE WILDERNESS OR ARCHEOLOGICALLY UNDERSTUDIED?

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ABSTRACT

Received opinion is that the Big Thicket of east Texas was uninhabited until the early nineteenth century. It was a pristine wilderness. This view is supported neither by archeological data nor historical records.

RESUMEN

La opinión aceptada es que el Big Thicket del este de Texas estuvo deshabitado hasta principios del siglo diez y nueve. Era una tierra virgen pristina. Este punto de vista no está apoyado ni en datos arqueológicos ni históricos.

Cozine (2004) and Callicott et al. (2006) maintain that the Big Thicket of east Texas was a wilderness prior to 1800. No one ever lived there. However, they do not cite any archeological sources in support of this position. We therefore undertook a study to determine the validity of their position because we previously had discovered that many pronouncements about the Big Thicket are incorrect (MacRoberts & MacRoberts 2004, 2007; MacRoberts et al. 2007) and because in the "great wilderness debate" many authorities maintain that the North American continent was not a pristine wilderness in 1492 but instead was a landscape that had been highly modified by Native Americans (Callicott & Nelson 1998; Denevan 1998; McCann 1999a, 1999b; Bonnickson 2000; Vale 2000; Williams 2000; Pyne 2001; Kay 2002; Mann 2005). However, some want it both ways. While Callicott et al. (2006:28) agree that colonists and explorers did not find a "howling wilderness" but a landscape "as much a cultural artifact as the one they left behind," they also state that "of course, throughout North America tracts of wilderness were … interspersed with more or less intensely peopled places." According to them, one such wilderness was the Big Thicket (Callicott et al. 2006: 29). Native Americans made only occasional hunting forays into it and the Spanish found it inhospitable.

A survey of the archeological literature on Native American presence in the Big Thicket, including the Big Thicket National Preserve, shows that archeological work is virtually non-existent (Shafer 1968; Shafer et al. 1975; McClurkan 1968; Story 1990b; Bousmann et al. 2004; Ricklis 2004). Compared with other regions of Texas, the archeological coverage of the Big Thicket is minuscule (Perttula 2004). Ricklis (2004) makes this clear in his recent review of southeastern Texas archeology in which he barely mentions anything except coastal areas. We, therefore, contacted Texas archeologists to confirm our findings and obtain current information on archeology in the Big Thicket. Victor Galan (pers. comm.) wrote that of the surveys that have been conducted in the Big Thicket region, few cover enough area with adequate testing methods, still fewer have good stratigraphic information, and even fewer yet have been thoroughly excavated. One of the findings of early archeological surveys in the Big Thicket region was that there appeared to be relatively few sites (Shafer et al. 1975). Whether this paucity of sites was due to masking by dense ground cover, or was an accurate reflection of limited human use was not clear (Shafer et al. 1975; Story 1990a). Years later, Shafer (pers. comm. March 13, 2008) states:

> "Given what I know now …I am convinced that we missed a lot of sites in the Big Thicket. A big part of the reason was visibility, and the fact that we did not do shovel testing then. Also, I'm sure erosion removed some of the sites as well."

Shafer (pers. comm., March 17, 2008) is currently of the opinion that the Big Thicket is archeologically understudied. There is, however, enough archeological evidence to indicate that man has been in the Big

J. Bot. Res. Inst. Texas 2(2): 1291 – 1293. 2008

Thicket since Paleoindian times (at least since 8,000 years ago) (Bousmann et al. 2004; Victor Galan pers. comm.).

The Spanish left a voluminous record of their presence in eastern Texas (Bolton 1914, 1915; Swanton 1942, 1946; Freeman 1990). The Spanish encountered Hasinai and Caddo tribes in the region of Nacogdoches and Natchitoches, and Attacapan tribes between Nacogdoches and the coast, mainly in the San Jacinto and Trinity river drainages (Bolton 1914, 1915; Swanton 1942, 1946; Perttula 1992). However, the Spanish had no interest in the eastern part of the Big Thicket (Newton, Jasper, Tyler and Hardin counties) because, rather than colonization, their aim was to prevent French encroachment by establishing forts and missions in areas where the French threatened. The French did not threaten the Big Thicket region, but threats existed north of the Big Thicket at Natchitoches and on the coast on the lower Trinity River. The Spanish repeatedly traveled across the western part of the Big Thicket (Polk, Liberty, San Jacinto counties) on their overland trips from Nacogdoches to their presidio and mission on the lower Trinity River (the Spanish appear to have never used waterways for travel). Consequently, the Spanish did not avoid the Big Thicket any more than they avoided other regions of Texas; they simply had no interest in the area.

In summary, the paucity of archeological research prevents any detailed understanding of Native American occupation of and impact on the Big Thicket. Until the Big Thicket is seriously explored archeologically, our understanding of Native American impact there will remain minimal. This, in turn, means that an understanding of Big Thicket "biocomplexity" (interrelation of "coupled human and natural systems") (Callicott et al. 2006; Liu et al. 2007) will ultimately have to include the archeologist.

ACKNOWLEDGMENTS

Victor Galan, Deep East Texas Archeological Consultants, and Harry Shafer provided information on Big Thicket archeology, directed us to some of the Big Thicket archeological literature, and reviewed the paper.

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BOOK REVIEW

Jim Wark and Joseph A. Mussulman. 2004. **Discovering Lewis and Clark from the Air.** (ISBN: 978-0878424894, pbk.). Mountain Press Publishing Company, P.O. Box 2399, Missoula, Montana 59806, U.S.A. (**Orders:** www.mountain-press.com, 800-234-5308). $40.00, 272 pp., color illustrations, 9 1/2" × 9 1/2".

Aerial photographer Jim Wark and history buff Joseph Mussulman have provided a very different view of the Lewis and Clark Expedition. The route is followed from the air, accompanied by step-by-step discussion of their route choices and explorations.

The idea of the book was simple enough. The authors flew a small plane over the route of the Corps of Discovery and took aerial photos of places along the trail. The principal impression one gets from these photos is how completely the landscape of 200 years ago has vanished—dammed up, paved over and plowed under. The rivers of Lewis and Clark's time (and it was mostly a river journey) are drowned under the slack water of dozens of dams, and where they are not drowned they are often channelized, straightened and otherwise "improved." So it is no surprise that many of the best photos here are of the mountain crossing: Beaverhead Rock, Tobacco Root Mountains, and Bitterroot Mountains. Each photo is illuminated by an analysis by the authors, accompanied by relevant quotations from the Lewis and Clark journals.

The book includes a section of supplemental reading, as well as a bibliography and index. It would be a good addition for public and college libraries that have a particular interest in the Expedition.—*Gary L. Jennings, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

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DIFERENCIAS EN EL USO DE PLANTAS ENTRE HOMBRES Y MUJERES EN UNA COMUNIDAD DE PIE DE MONTE DEL NORTE DEL ECUADOR

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RESUMEN

En esta comunidad colona se registraron 298 especies de plantas, de estas el 31% fueron señaladas por hombres, el 40% por mujeres y las restantes especies son utilizadas por ambos. El uso y conocimiento que tienen de las plantas hombre y mujeres está influenciado por su trabajo y roles. Al incluir una variable social como el género, en investigaciones de etnobotánica, se puede mejorar el entendimiento de los ecosistemas, su biodiversidad y la gente que los usa.

ABSTRACT

In this community 298 species of plants were identified by local informants. Of these, 31% are used by men, 40% by women and the rest by both. Men and women's knowledge and use of plants are influenced by work and gender roles. I believe that the inclusion of social variables, such a gender in ethnobotanical research, can improve the understanding about ecosystems and human use of biodiversity.

INTRODUCIÓN

La Etnobotánica es un campo interdisciplinario, considerado como una herramienta indispensable para establecer estrategias de conservación y manejo (Cunningham 2001). Permite de manera rápida, conocer las especies más utilizadas, formas de usos y otros datos relacionados con la interacción de las personas con las plantas (Plotkin 1995). En la mayoría de trabajos etnobotánicos, los botánicos y botánicas han dado gran importancia a la flora y han dejado de lado las características socioeconómicas y culturales de sus informantes (Arango 2004). Entre los aspectos sociales que se ha dejado de analizar se encuentran las diferencias de *género* en el conocimiento, uso y control de las plantas.

El género según Rodríguez et. al. (2004) se refiere a las relaciones construidas socialmente entre mujeres y hombres, culturalmente e institucionalmente incorporadas, que varían por sitio, situación contexto y tiempo. El incluir esta variable social en investigaciones sobre etnobotánica, puede permitir visualizar la diferencia que existe en el conocimiento y usos que hombres y mujeres dan a las plantas.

El conocimiento diferente que hombres y mujeres pueden tener sobre el uso de las plantas, no implica, según Joekes (2004), una línea de género per se, si no más bien conocimiento diferenciado por las formas de uso, roles y labores que hombres y mujeres desempeñan en su comunidad. Estas diferencias del conocimiento basadas en la división social del trabajo, determina que hombres y mujeres podrían tener conocimientos especiales de la flora de entorno (Agarwal 1994).

Al incorporar la variable de género, en la presente investigación etnobotánica en una comunidad colona de pie de monte en el norte del Ecuador, se buscaba mostrar las diferencias que hay en el uso y conocimiento de plantas, entre hombres y mujeres.

METODOLOGÍA

La comunidad de San Jacinto de Chinambí, donde se realizó la investigación, está ubicada en el norte del Ecuador, en la provincia del Carchi, entre el territorio del pueblo indígena Awá y el bosque protector Golondrinas, en el pie de monte de la cordillera occidental de los Andes. En este lugar viven 30 familias de descendencia: Awá, afroecuatoriana proveniente del Valle del Chota, y mestiza procedente de varios lugares

J. Bot. Res. Inst. Texas 2(2): 1295 – 1308. 2008

de la Sierra del Ecuador y del sur occidente de Colombia. Los primeros asentamientos colonos se dieron hace casi cincuenta años (Comunidad de San Jacinto 2005).

El territorio de la comunidad de San Jacinto está atravesado por el río Chinambí, formado por el aporte de varias quebradas, que nacen en la zona alta. A su alrededor se encuentran zonas planas que a medida que se alejan del río, forman pendientes más pronunciadas. La parte sur del territorio ha sido utilizada para la producción agropecuaria, mientras que la norte, donde se encuentran las pendientes más acentuadas, esta representada por remanentes de bosques. La cabecera norte del territorio tiene una cuchilla desde donde se extiende el territorio comunal (Comunidad de San Jacinto 2005). La altitud de los territorios en la comunidad de San Jancito de Chinambí va desde los 960 msnm hasta los 2400 msnm, y pertenece a las formaciones vegetales de *bosque siempre verde pie montano* (Cerón et. al. 1999), *bosque siempre verde montano bajo y de neblina montano* (Valencia et. al. 1999).

Basado en el hecho de que la comunidad se originó por asentamientos de personas colonas, se decidió tomar como unidad de análisis e interacción la finca[1], que es un espacio social y económicamente construido, donde se puede encontrar un mosaico de ecosistemas. La investigación fue realizada en nueve fincas de diferentes familias, ubicadas al azar dentro del territorio de la comunidad. Con cada familia se trabajó dos días completos, un día con el hombre y al otro con la mujer. Para lograr el apoyo durante todo el día y no interferir con sus tareas diarias, a cada participante se le pagó el diario o jornal (salario por un día de trabajo en la comunidad). En el caso de las mujeres, para que ellas pudieran participar y no se preocupen de incumplir con sus labores diarias en sus hogares, se pagó a otra persona, para que ese día cuide a las hijas e hijos pequeños y prepare la comida para toda la familia. Este pequeño detalle ratificó que las mujeres en la comunidad de San Jacinto, como las de otras partes del Ecuador, en un mismo día cumplen doble trabajo (reproductivo y productivo); algunas también realizan actividades comunitarias y religiosas como: organización de festejos comunales, reuniones escolares y del cabildo entre otras. Todas estas actividades hicieron que el tiempo que las mujeres pudieran aportar a la presente investigación fuese menor.

Los recorridos fueron planificados por las y los encuestados en la noche del día anterior y siempre se trató de no influenciar en la decisión de las personas sobre el sector a visitar al día siguiente. Con los recorridos se recolectó plantas en los huertos, remanentes de bosque, jardines e incluso en las macetas que cuidan en sus casas. Con las personas encuestadas se anduvo por los lugares donde recolectan o cultivan sus plantas.

Para registrar los usos de las plantas se utilizó una encuesta en la que se anotó algunas características como: lugar donde se encontraba, parte de la planta que se usa, si la especie era cultivada o silvestre. Además de estos datos, se apuntó el hábito, la presencia de látex, resina, flores o frutos. A cada planta mencionada por las personas de la comunidad se le asignaba un número de encuesta a partir del 001. De cada especie se colectó entre dos y cuatro especímenes que fueron prensados en papel periódico y preservados en alcohol al 70% (Cerón 2003). Cada muestra colectada se registró en el catálogo de campo desde el número de colección DS 1593 al 1925, estas fueron identificadas por comparación con la colección que descansa en el Herbario Nacional del Ecuador (QCNE). Los especímenes de esta investigación reposarán en el QCNE y CHEP.

RESULTADOS Y DISCUSIÓN

En la comunidad de San Jacinto se registraron 298 especies de plantas usadas, de éstas el 31% fueron señaladas por hombres y el 40% por mujeres, las restantes especies utilizaban ambos. Las familias más importantes por número de especies usadas por las mujeres son: Solanaceae, Araceae, Lamiaceae, Poaceae, Asteraceae, Fabaceae y Urticaceae, mientras que los hombres utilizan las familias Moraceae, Myrtaceae, Lauraceae, Meliaceae, Rubiaceae, Solanaceae y Actinidaceae. Hombres y mujeres coincidieron en el uso de las siguientes familias en orden de importancia: Poaceae, Asteracea, Rutaceae, Meliaceae, Euphorbiacae, Clusiaceae y Lamiacae. El listado de las especies esta en el apéndice 1.

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[1] La finca es el territorio adquirido por posesión o compra; no marca un legado tradicional comunitario, pero sí un saber familiar traspasado de padres y madres a hijos e hijas.

En las 18 personas de la comunidad de San Jacinto de Chinambí encuestadas se registró un promedio de 46,6 plantas usadas por persona (Fig. 1). A pesar que las mujeres de la comunidad conocen en promedio más usos de las plantas (54,7 plantas), que las que conocen los hombres (38,5 plantas), la diferencia no es estadísticamente significativa (Anova F= 2,58; p=0,127). Una cosa interesante a observar en la figura 1, es que a pesar de que los hombres conocen menos plantas que las mujeres, el conocimiento entre ellos es más homogéneo. Entre las mujeres encuestadas hay algunas que en su casa solo hacen trabajos domésticos, mientras que otras por ser madres solteras tiene que administrar la finca, y cuidar a sus hijos-as. Esta diferencia de trabajo hace que en ellas el conocimiento también sea variable (Fig.1). Mientras que la mayoría de hombres se dedican sólo a trabajos agropecuarios y de extracción de madera por eso su conocimiento puede ser más homogéneo.

La mayoría de plantas que utilizan los hombres son silvestres, mientras que las mujeres utilizan más plantas cultivadas (Fig. 2). El hombre utiliza más plantas que esta extrayendo de ecosistemas naturales, mientras que las mujeres están utilizando más especies de ecosistemas antropogénicos (agroecosistemas). Por ende la mayor parte de las plantas que las mujeres utilizan están en el huerto (zona de cultivos con parches de bosque) dentro de la finca. Mientras que los hombres utilizan plantas del bosque (Fig. 3). Esta diferencia estadísticamente significativa del lugar en donde extraen las plantas (Anova F=10,172; p<0,05), está ligada también al trabajo que cada persona realiza. Incluso hay mujeres que nunca visitan la zona de bosque comunitario, por varias razones, entre las que ellas mencionaron estaban: *la lejanía, falta de interés o el excesivo trabajo en su casa*. Mientras que los hombres tienen mucho interés en la zona del bosque, porque aún es posible encontrar allí, especies de madera fina o suelo apto para la agricultura.

El huerto es la parte de la finca donde se mezclan fragmentos de bosques en regeneración, zonas de pasto, cultivos y la casa de la familia, es un mosaico de hábitats donde las personas colonas están manejando sus recursos. Este lugar según Álvarez (2005) y Rocheleau et. al. (2004), es un ámbito fundamentalmente femenino y un espacio de replicación de la cultura, pero no siempre las mujeres pueden tomar decisiones sobre él. Además las mujeres mantienen en la casa, ya sea en maceteros o en el jardín (a un lado de la casa) varias especies de plantas, traídas de otros sectores fuera de San Jacinto o del bosque local, esto lo hacen para: *alegrar la casa o tenerlas más cerca*. Mientras que los hombres no acostumbran a mantener plantas en este espacio (Fig. 2). Esta necesidad de las mujeres de mejorar el entorno de la casa, también fue mencionada por mujeres colonas brasileñas en la investigación Kainer & Duryea (1992) y por mujeres indígenas Zenúes en Colombia (Álvarez 2005).

Las mujeres usan más hierbas (Fig. 4) que los hombres, mientras que ellos usan más árboles que ellas. Esta diferencia significativa de los hábitos de las plantas usadas (Anova F=9,088; p<0,05), muestra que hombres y mujeres ven a los ecosistemas de manera diferente. Por ejemplo mientras las mujeres están usando más el sotobosque (arbustos, hierbas), los hombres conocen y usan más especies del dosel (árboles). Aunque esta apreciación no es absoluta, concuerda con la encontrada por Phillips & Gentry (1993) en Perú, que los hombres conocen más especies de bosque (árboles), mientras que las mujeres conocen más hierbas (plantas no boscosas).

Al preguntarles a los hombres y las mujeres, que parte de la planta utilizan, respondieron en la mayoría de casos que todo el individuo. En el caso de los hombres al utilizar la madera del árbol, tienen que extraer a todo el individuo, a pesar de que sólo utilizan la parte comercial del tronco y el resto la dejan para que se descomponga en el bosque, o dependiendo de la madera la utilizan para leña. Mientras que las mujeres, como la mayor parte de plantas que utilizan son hierbas, ellas también extraen todo el individuo, es obvio que arrancar una hierba, es menos destructivo que talar un árbol. Dependiendo de la intensidad de uso, el utilizar toda la planta podría ser considerado como un uso destructivo, y extraer solo una parte como uso no destructivo, o sostenido (Caniago & Siebert 1998; Correte et. al. 2005). A pesar de que en la presente investigación no se consideró esta idea al momento de diseñarla, es conveniente mencionar que Caniango & Siebert (1998), *manifiesta que si el uso de toda la planta de una especie es intensivo, puede ocasionar la pérdida de la especie*.

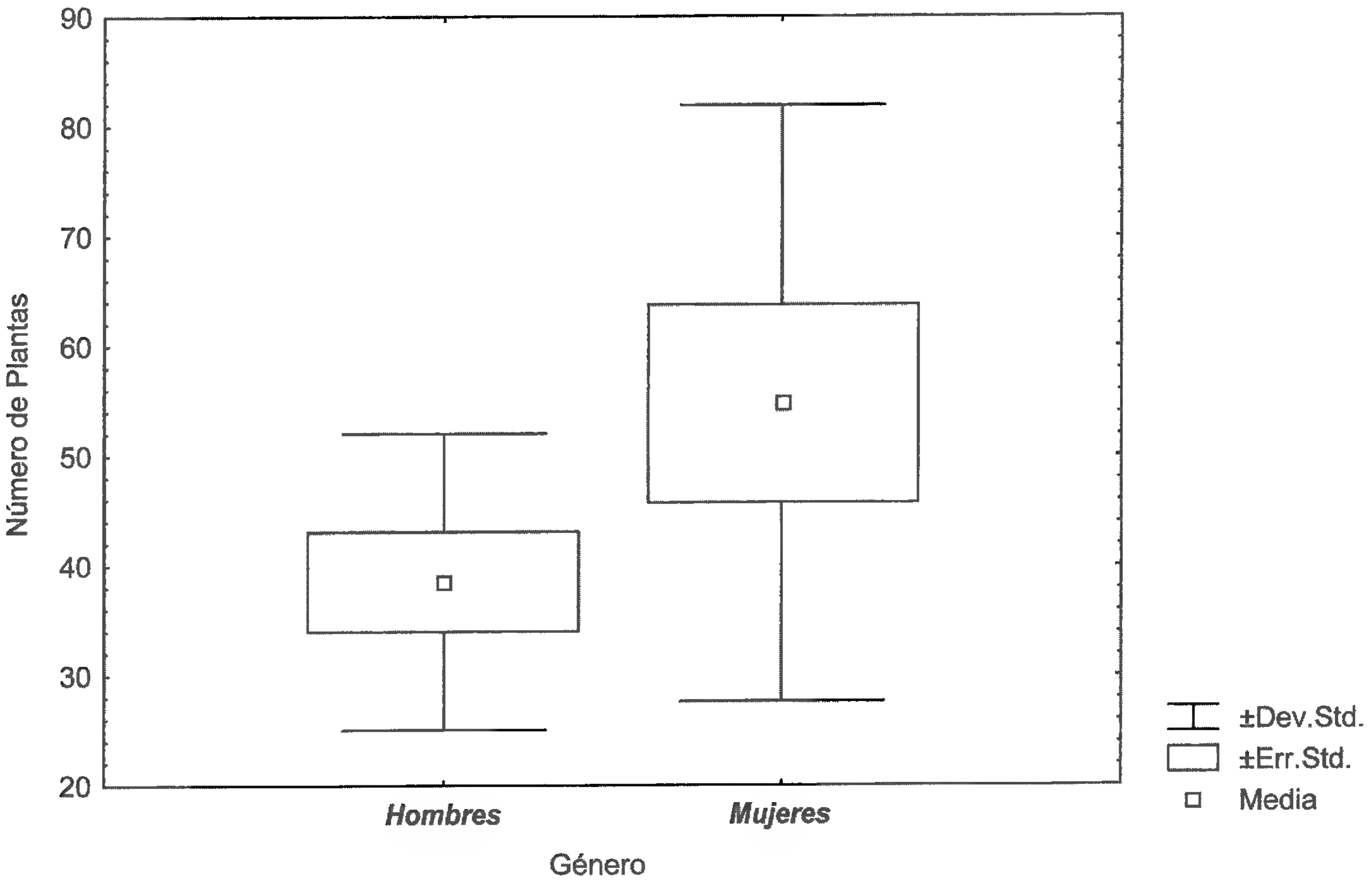

Fig. 1. Diferencias en el número de las plantas que usan hombres y mujeres (F= 2,58; p=0,127; n=18).

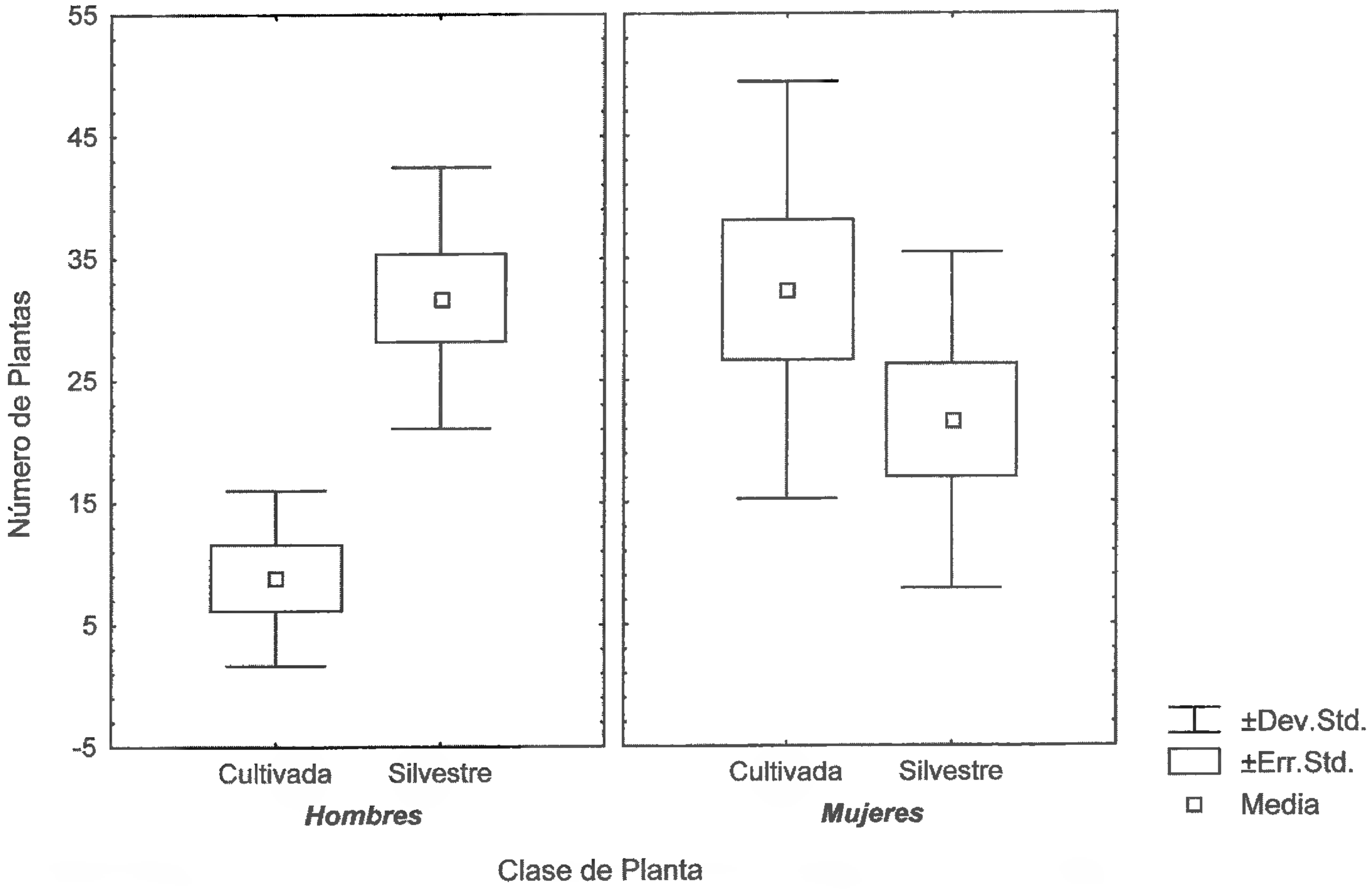

Fig. 2. Diferencias en la clase de plantas que usan hombres y mujeres (F=3,57; p<0,05; n= 24).

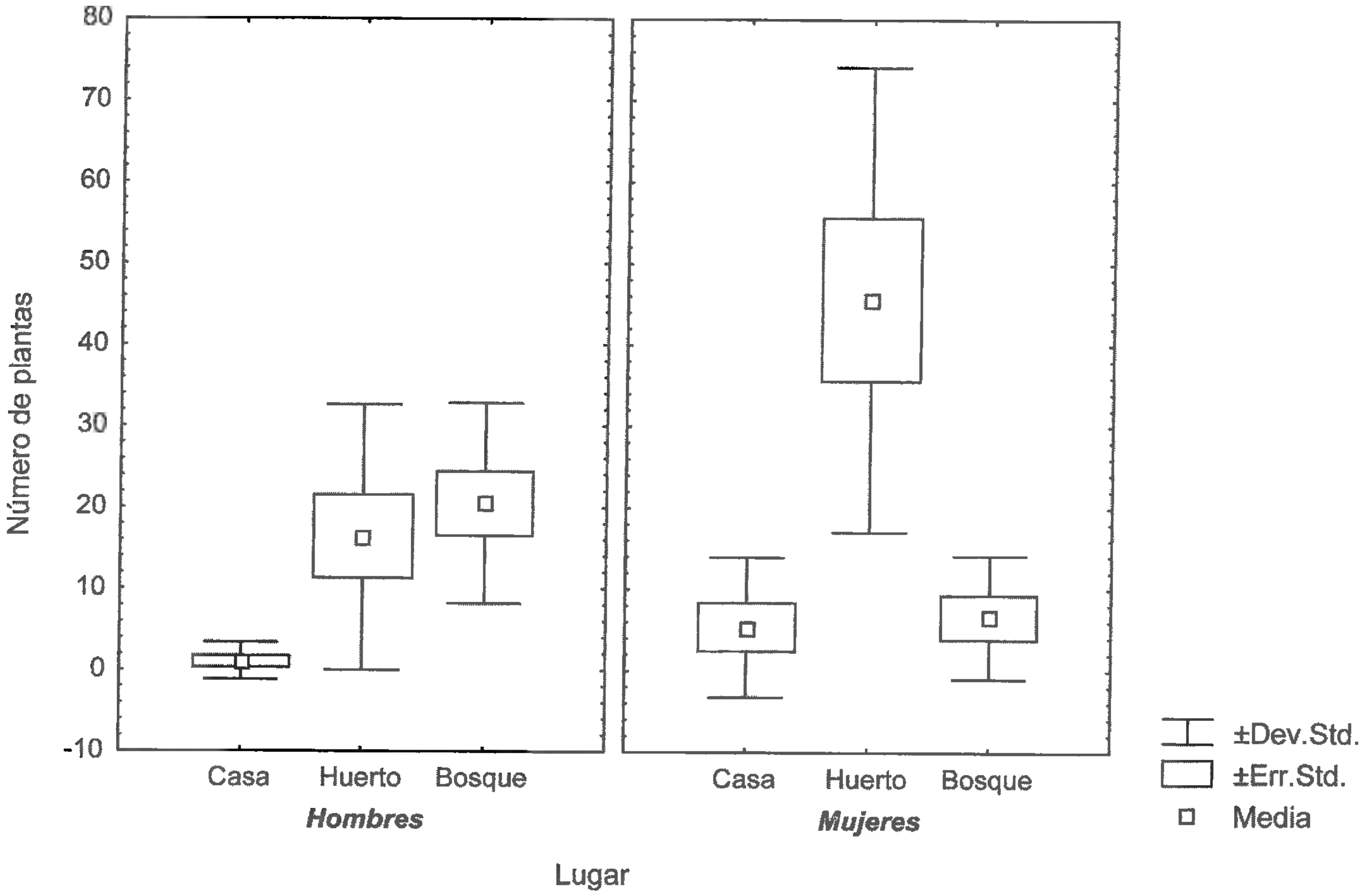

FIG. 3. Diferencias en el lugar en donde están las plantas que usan hombre y mujeres (F=10,172; p<0,05; n=54).

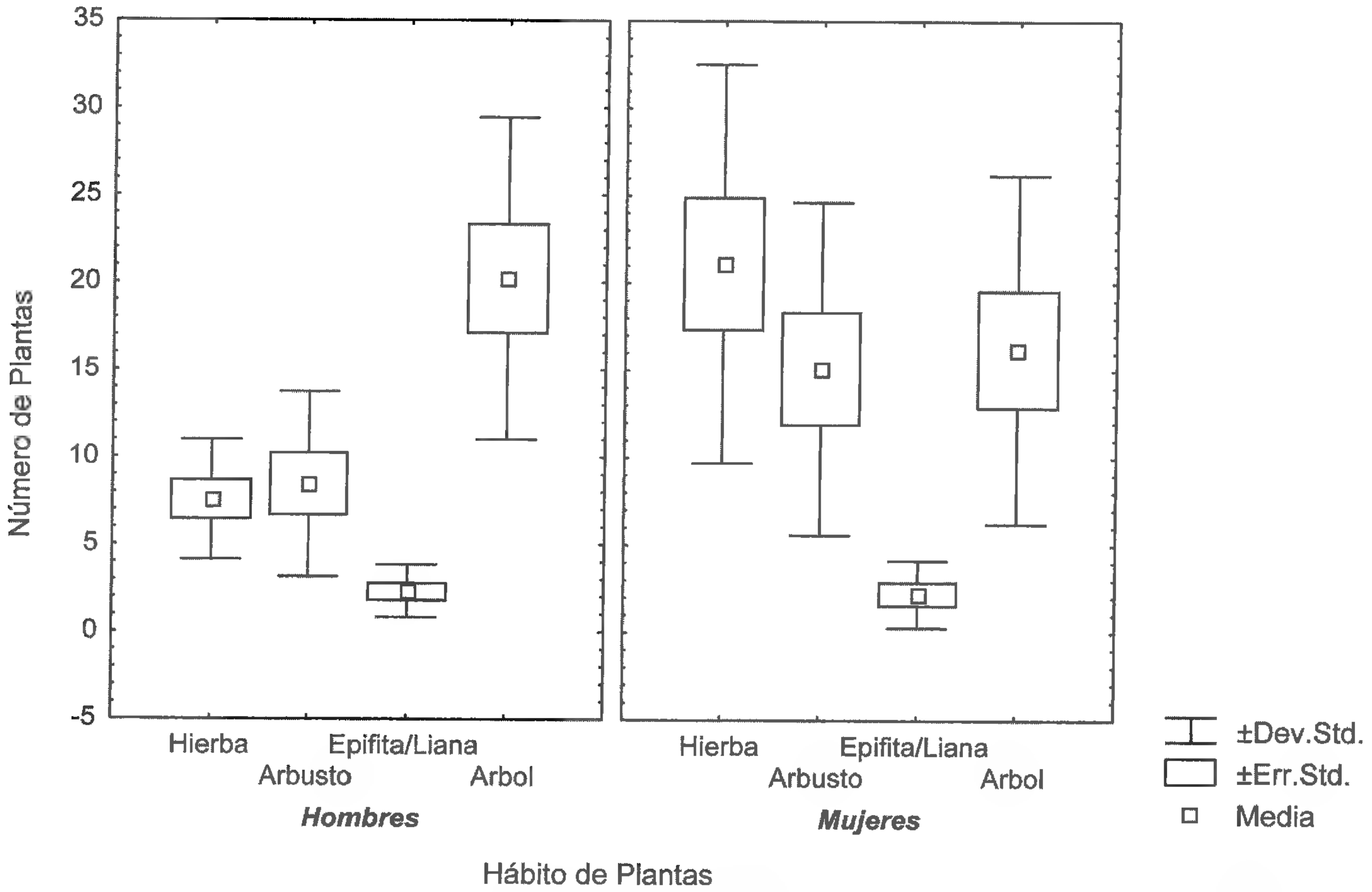

FIG. 4. Diferencias del hábito de las plantas que usan hombres y mujeres (F=9,088; p<0,05; n=72).

En relación a los usos de las plantas, también existe una diferencia por género (Anova F=6,433; p<0,005), los hombres mencionaron un mayor número de plantas con uso maderable, mientras que las mujeres mencionaron más especies con uso alimenticio (Fig. 5). Estos resultados concuerdan con los encontrados por Arango (2004) en Colombia y Figueiredo et. al. (1993) en Brasil. Estos autores-as sugieren que esta diferencia en el conocimiento de plantas está ligada a las actividades que hombres y mujeres tienen en su comunidad.

Es notable la diferencia que existe entre hombres y mujeres en el conocimiento y uso de plantas ornamentales, para ellas el tener plantas *"bonitas"* cerca de la casa es importante, porque hace a la casa más acogedora. Mientras que para los varones no son importantes las especies ornamentales, porque no tiene valor comercial actual y ellos no están pensando en el arreglo del hogar. Esta respuesta de las mujeres de San Jacinto sobre las plantas ornamentales concuerda con lo manifestado por mujeres de Cachoeira en Brasil, en la investigación de Kainer & Duryea (1992). Algunos varones que mencionaron especies silvestres con uso ornamental, estaban pensando en manejar estas plantas, pero hasta el momento no habían hecho intentos de plantarlas fuera del bosque.

En cuanto a las plantas con uso medicinal las mujeres conocen más especies que los hombres, esta diferencia también la mencionan Caniago & Siebert (1998) en un trabajo realizado en Indonesia. Este contraste según Rocheleu et. al. (2004) se debe a que la responsabilidad del cuidado de la salud de las familias rurales, está siempre a cargo de la mujer. Algunas de las plantas medicinales que ellas mencionaron dentro de la encuesta, no son nativas de San Jacinto, más bien fueron traídas por las personas cuando colonizaron la zona (*Ocimum campechianum* Mill., *Salvia alvajaca* Oerst., *Ruta graveolens* L., *Verbena litoralis* Kunth, entre otras). Esto concuerda con lo realizado por los habitantes de una comunidad rural de *Conceição-Açu* que al colonizar llevaron consigo las especies medicinales tradicionales más utilizadas (Correte et. al. 2005).

Cuando se preguntó sobre la dosis o posología de algunas especies medicinales, algunas de las entrevistadas, no sabían, porque no había utilizado la especie, pero conocían por tradición su uso. Al preguntarles, porque no las usaban algunas de ellas decían: *que era más fácil y seguro salir al centro de salud, cuando alguien estaba enfermo-a, mientras que otras decían que usaban las plantas hasta poder salir a ver al médico, o cuando las medicinas no funcionaban bien.* Casi todas las plantas medicinales mencionadas por los hombres se encuentran en el bosque, incluso muchas están ligadas a cicatrización o el alivio de las quemaduras producidas por la motosierra. Un ejemplo es la resina de *Cyathea pallescens* (Sodiro) Domin, que aparece cuando se corta a esta planta para facilitar las labores de extracción de madera, como esta planta produce una resina gelatinosa, en el caso de sufrir una quemadura con la motosierra, ellos se colocan sobre la parte quemada esta resina, para aliviar el ardor y seguir trabajando.

Al categorizar las especies encontradas en San Jacinto, según los criterios de origen: endémica, nativa, cultivado o introducida al país, propuestos por Jørgensen & León-Yánez (1999) y Valencia et. al. (2000) se encontró que la mayoría de plantas que utilizan las personas son especies nativas del Ecuador (Fig. 6), a pesar que también usan especies introducidas. Las mujeres son las que más especies introducidas usan, muchas de las cuales son ornamentales. Un problema con estas plantas ornamentales e introducidas, es que con el pasar de los años, algunas de estas especies se pueden convertir en plagas difíciles de erradicar. Hasta el momento este hecho no es preocupante en la zona de estudio, pero existen muchos casos en Ecuador de especies ornamentales que se han convertido en plagas (como en las Islas Galápagos y otras áreas naturales), pero no se logró encontrar en la literatura si estas plantas fueron introducidas por hombres o mujeres. *Lantana camara* L. es un ejemplo interesante de diseminación de especies ligadas al género, ya que esta especie fue llevada por la esposa del gobernador de Ceylon, por los colores de las flores, desde Brasil hasta su jardín en Indo-China. De su jardín esta planta se diseminó por toda la India e Indo-China ocasionado algunos problemas a la flora nativa (Morton 1994). En San Jacinto las mujeres no usan muchas plantas nativas del bosque, y no se registró ni una sola especie endémica para el Ecuador, que es usada exclusivamente por estas mujeres. En cambio los hombres de esta comunidad usan más plantas nativas y endémicas, porque aún siguen extrayendo recursos del bosque nativo. Las especies endémicas para el Ecuador que utilizan las personas de San Jacinto están mencionadas en el cuadro 1.

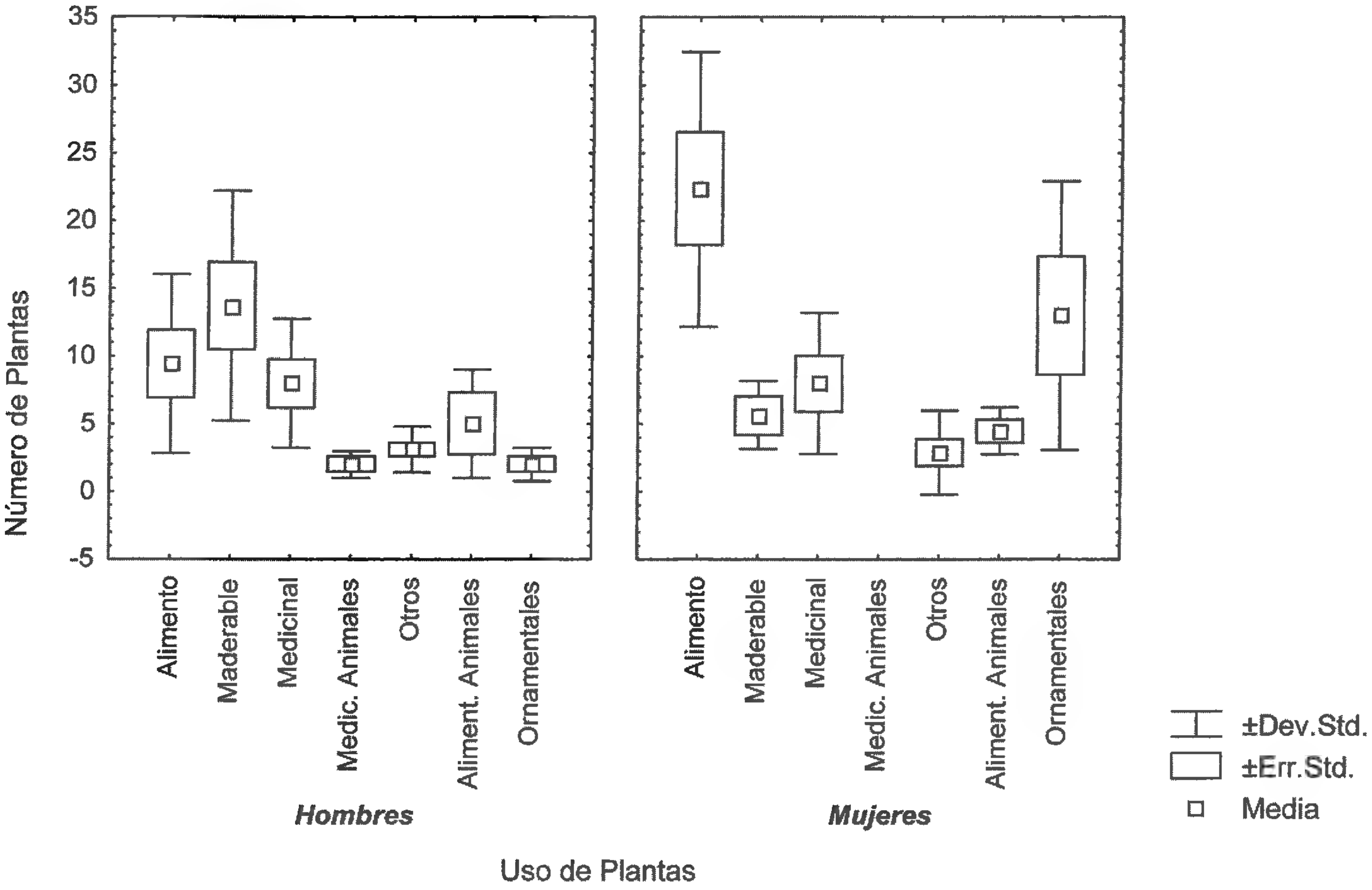

Fig. 5. Diferencias en el uso de plantas entre hombres y mujeres (F=6,433; p<0,05; n=74).

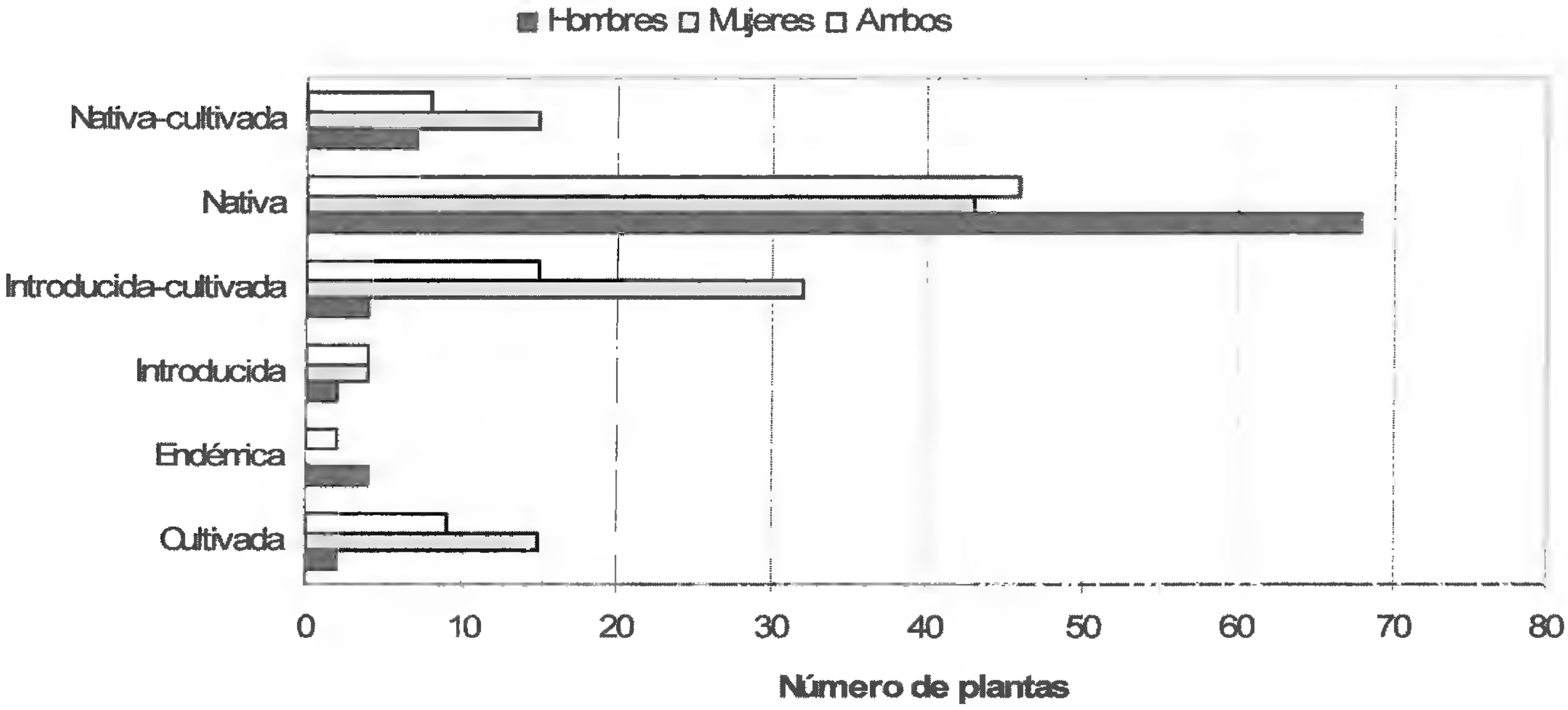

Fig. 6. Plantas que usan hombres y mujeres según la categoría de origen propuesta para el Ecuador (Jørgensen, P. y S. León-Yánez 1999 y Valencia et. al. 2000)

Las personas colonas a pesar de que han sido tachados siempre de destructoras de los ecosistemas naturales, o como personas con pocas tradiciones, tienen un importante conocimiento sobre las plantas que es necesario rescatar. Además este saber se va acrecentando, según van pasando los años de asentamiento de la comunidad, ya que la gente cada nuevo día trata de entender mejor el nuevo ecosistema donde vive, para sacarle más provecho. Según Joekes (2004) *las mujeres y hombres aprenden lo que necesitan saber, lo cual depende de su relación práctica con el recurso mismo en términos de la división genérica del trabajo que se da en la localidad*. El entender como usan estas personas las plantas, puede dar pautas para proponer estrategias más prácticas para la conservación de la biodiversidad, especialmente en lo referente a domesticación y manejo de algunas especies.

Las personas de la comunidad de San Jacinto conocen diversas especies de plantas que las encuentran en diferentes lugares en su comunidad. El conocer cada uno de estos ecosistemas y su biodiversidad depende de los roles y el trabajo que desarrolla cada una de las personas en su familia y comunidad. Esto ratifica lo propuesto en otras investigaciones sobre el tema (Arango 2004; Figueiredo et. al. 1993; Joekes 2004; Rocheleau 1998) El incluir una variable social como el género, en investigaciones de botánica o de ecología, pueden llevar a tener un mejor entendimiento de los ecosistemas, su biodiversidad y la gente que los usa. Aportando de esta forma importante información para su conservación y manejo.

Cuadro 1. Especies endémicas del Ecuador usadas en la comunidad de San Jacinto.

Familia	**Especie**	**Categoría UICN**
Actinidiaceae	*Saurauia herthae* Sleumer	LC
Bromeliaceae	*Pitcairnia ferrel-ingramiae* M. Lutter & Dalistione	VU
Melastomataceae	*Conostegia centronioides* Markgr	LC
Melastomataceae	*Meriania drakei* (Cogn.) Wurdack	LC
Moraceae	*Ficus lacunata* Kvitvik	VU
Passifloraceae	*Passiflora montana* Holm-Niels & Lawesson	EN

LC: Preocupación menor VU: Vulnerable EN: En Peligro

APÉNDICE 1

Lista de especies usadas por hombres y mujeres de San Jacinto de Chinambi

G=Informante (**H**=Hombre, **M**=Mujer), **HA**=Hábito (**A**=Árbol, **Ab**=Arbusto, **H**=Hierba, **He**=Hemiepífita, **L**=Liana, **E**=Epífita; tomados de: Jørgensen, P. y S. León-Yánez 1999 y Valencia et. al. 2000), Uso (**M**=Maderable, **Me**=Medicina, **A**=Alimento, **Aa**=Alimento de animales, **MeA**=Medicina de animales, **Or**=Ornamental, **Ot**=Usos variados), Nombre común (entre comillas se encuentran las plantas que no tenían nombre común pero si uso y las plantas que tenían un nombre pero era particular de la persona encuestada). En esta lista no se incluyen las morfoespecies sin nombre científico o género.

Nombre científico	**G**	**HA**	**Nombre común**	**Uso**
Abutilon dianthum C. Presl	H	Ab	Jarabe	M
Acalypha diversifolia Jacq.	HyM	Ab	Pigua	Me
Acmella brachyglossa Cass.	HyM	H	Botoncillo	Me, A
Acmella repens (Walter) Rich	HyM	H	Botoncillos	Me
Acrostichum sp.	H	H	Helecho	A
Adenostemma platyphyllum Cass	HyM	H	Mama Juana	MeA, Me
Aechmea strobilacea L.B. Sm.	M	H	Pita	A
Agave americana L.	HyM	H	Cabuya	Ot
Ageratina sp.	M	Ab	"Sin nombre"	Me
Allamanda cathartica L.	M	Ab	"Flor amarilla"	Or
Aloe vera (L.) Burm. f.	HyM	H	Sábila	Or
Alternanthera mexicana (Schltdl.) Hieron.	M	H	Escancel	Me
Anacardium occidentale L.	H	A	"Sin nombre"	M, Aa
Ananas comosus (L.) Merr.	HyM	H	Piña	A

Nombre científico	G	HA	Nombre común	Uso
Annona montana Macfad.	HyM	A	Guanábana	A
Annona muricata L.	M	A	Guanábana	A
Anomospermum chloranthum Diles	M	L	"Sin nombre"	A
Anthurium andraeanum Linden	HyM	E	Corazón de la selva	Or
Arachis hypogaea L.	M	H	Maní	A
Axonopus micay García-Barr.	HyM	H	Pasto Micay	Aa
Baccharis sp.	M	Ab	Chilca morada,	Me
Baccharis trinervis Pers.	HyM	Ab	Chilca, Chilca blanca	Me
Bactris corosilla H. Karst	H	A	"Sin nombre"	M
Bactris gasipaes Kunth	M	A	Chonta Duro	A, Me
Begonia fischeri Schrank	M	H	Chulco	Me
Begonia parviflora Poepp. & Endl.	H	Ab	Peluca, Jabón	Ot,Or
Beilschmiedia costaricensis (Mez & Pittier) C.K. Allen	M	A	María	M
Bidens cynapiifolia Kunth	HyM	H	Pacunga	Me
Billia columbiana Planch. & Linden	HyM	A	Pone huevos	M
Bixa orellana L.	HyM	A	Achote	A,Ot
Borojoa sp.	M	A	Borojó	A
Brassica napus L.	M	H	Nabo	A
Brugmansia arborea (L.) Lagerh.	M	Ab	Floripondio	Or
Brunfelsia grandiflora D. Don	M	Ab	"Sin nombre"	Or
Brunfelsia chiricaspi Plowman	H	Ab	Flor de madre	Or
Bryophyllum pinnatum (Lam.) Oken	M	H	Hoja Santa	Or, Me
Bunchosia argentea (Jacq.) DC.	HyM	Ab	Pendo	M
Calathea metallica Planch. & Linden	M	H	Achira	Ot
Calathea crotalifera S.Watson	M	H	Hoja blanca	A
Calathea marantifolia Standl.	HyM	H	Hoja de Bijao	Or, Ot
Calyptranthes cf. *plicata* McVaugh	H	A	Pisulde	Ot
Campomanesia lineatifolia Ruiz & Pav.	HyM	Ab	Guayabiila, Guabilla	A,Aa,M
Canna indica L.	M	H	Alcira	Or
Capsicum annuum L.	M	H	Ají	A
Cardamine bonariensis Pers.	HyM	H	Berro	A, Me
Carica microcarpa Jacq.	HyM	A	Col de monte	A
Carica papaya L.	H	A	Papaya	A
Casearia sp.	H	Ab	Guión	M
Castilla sp.	M	A	Caucho	Ot
Cecropia sp.	H	A	Yarumbo	M
Cedrela montana Moritz ex Turcz.	HyM	A	Cedrillo, Cedro	M
Centropogon cornutus (L.) Druce	HyM	H	Gallito	A
Chenopodium ambrosioides L.	M	H	Paico	Me
Chusquea sp.	HyM	Ab	Suro	Or
Cinchona pubescens Vahl	H	A	Achotillo	M
Citrus sp.	M	A	Limón Meyer	A
Citrus aurantifolia (Christm.) Swingle	HyM	Ab	Limón real	A
Citrus maxima (Burm. ex Rumph.) Merr.	HyM	A	Naranja, Naranja agria	A, Me
Citrus medica L.	HyM	A	Limón	A, Me
Citrus reticulata Blanco	HyM	A	Mandarina	A
Cladocolea sp.	M	Ab	Suelda	Me
Cleome hassleriana Chodat	M	Ab	Pestaña de Ángel	Or
Clusia magnifolia Cuatrec.	HyM	A	Madroño de monte	A,Or,M
Codiaeum sp.	M	Ab	"Hojas con puntos amarillos"	Or
Coffea arabica L.	HyM	Ab	Café	A
Coix lacryma-jobi L.	M	H	San Pedro	Ot
Colocasia esculenta(L.) Schott	HyM	H	Papa balsa o de monte	A
Columnea medicinalis (Wiehler) L.E. Skog & L.P. Kvist	H	H	Ataja sangre	Me
Conostegia centronioides Markgr.	HyM	Ab	Palo amarillo	M, Ot
Cordia sp.	H	A	Huevo de pava	Aa

Nombre científico	G	HA	Nombre común	Uso
Cordia hebeclada I.M. Johnst.	M	A	Hojarasca	M
Cordia mexiana I.M. Johnst.	H	A	Huevo de pava	Aa
Cortaderia jubata (Lemoine) Stapf	HyM	H	Saboya, Sobretana	A, Aa
Costus guanaiensis Rusby	H	H	Caña agria	Ot
Costus lima K. Schum.	HyM	H	Caña agria	Me
Coussapoa herthae Mildbr.	H	He	Matapalo	M
Coussarea latifolia Standl.	HyM	Ab	Murciélago	M
Cucurbita moschata Duchesne	M	V	Sapallo	A
Cupania cinerea Poepp.	HyM	A	Guabo de monte, Sabalito	M, A
Cyathea caracasana (Klotzsch) Domin	M	A	"Sin nombre"	Or, Ot
Cyathea pallescens (Sodiro) Domin	H	A	Helecho	Me
Cyclanthera pedata (L.) Schard.	HyM	V	Achogcha	A
Cymbopogon citratus (DC.) Staff	M	H	Hierba Luisa	Ot,Me
Dacryodes cupularis Cuatrec.	H	A	Copal	M
Daucus carota L.	HyM	H	Zanahoria	A
Dendropanax macrocarpus Cuatrec.	H	A	Chonta	M
Dieffenbachia cf *seguine* (Jacq.) Schott	M	H	Hoja blanca	Or
Diplazium trianae (Mett.) C. Chr.	M	H	Hielo del monte	A
Drymonia turrialvae Hansa.	H	H	"Sin nombre"	Or
Elateriopsis spectabilis Mart. Crov.	M	V	Vena	Ot
Eleocharis elegans (Kunth) Roem. & Schult.	HyM	H	Totora, Totorilla	Me,Ot
Endlicheria cf *browniana* Mez	H	A	Yalte	M
Eschweilera aff *integrifolia* (Ruiz & Pav. Ex Miers) R. Knuth	H	A	Tete	M, Aa
Eschweilera cf *pittieri* R. Kunth	HyM	A	Pilche	M
Eschweilera cf. *rimbachii* Standl.	HyM	A	Canelo	M
Eschweilera rimbachii Standl.	H	A	Tete, Canelo	M
Eugenia sp.	H	A	Arrayán	M
Euphorbia milii Des Moul.	M	Ab	"Flores rojas con espinas"	Or
Euterpe sp.	HyM	A	Chaparral	A
Euterpe precatoria Mart.	HyM	A	Palmito	A
Faramea fragrans Standl.	M	Ab	Café silvestre	A
Ficus sp.	HyM	He	Matapalo	M
Ficus andicola Standl.	H	He	Matapalo	M
Ficus cf *carica* L.	H	A	Higüerillo	Me
Ficus lacunata Kvitvik	H	A	Higuerón	M,Aa
Ficus pertusa L.f.	M	He	Matapalo	M
Garcinia madruno (Kunth) Hammel	HyM	A	Madroño de monte	A, Ot
Guadua agustifolia Kunth	HyM	A	Guadúa	Ot
Guarea cartaguenya Cuatrec.	HyM	A	Chalde	M
Guarea cf. *polymera* Little	HyM	A	Sabalito	Ot
Guarea kunthiana A. Juss.	H	A	Chalde, Chachaco	M
Guarea macrophylla Vahl	M	A	"Sin nombre"	M
Guarea polymera Little	HyM	A	Copal	M
Guatteria megalophylla Diles	H	A	Tete	M
Guzmania lingulata (L.) Mez	H	He	Vicundo pequeño	Or
Gynerium sagittatum (Aubl.) P. Beauv.	M	H	Caña Blanca	A
Hedyosmum cuatrecazanum Occhioni	H	A	Guayusa	A, Me
Hedyosmum goudotianum Solms	M	Ab	Guayusa	Me
Helianthus annuus L.	M	H	Girasol	Or
Heliconia sp.	HyM	H	Platanillo	Or
Heliconia nigripraefixa Dodson & A.H.Gentry	M	H	Platanillo	Ot
Heliconia burleana Abalo & G.L. Morales	H	H	Platanillo	Or
Hemarthria altissima (Poir.) Stapf & C.E. Hubb.	HyM	H	Pasto tropical	Aa
Heteranthera reniformis Ruiz & Pav.	M	H	Gallo de monte	A
Heteropsis sp.	H	He	Vena de mimbre	Ot

Nombre científico	G	HA	Nombre común	Uso
Hibiscus rosa-sinensis L.	M	Ab	Flor rosada, F. blanca	Or
Hydrangea macrophylla (Thunb.) Ser.	M	Ab	Hortensia	Or
Hyeronima sp.	H	A	Motilón	M
Hyeronima macrocarpa Müll. Arg.	H	Ab	Motilón	M.A
Hyptis verticillata Jacq.	HyM	H	Verbena, Chivo	Me
Impatiens balsamina L.	M	H	Amerindia, Miramelindo	Or
Inga sp.	HyM	A	Guaba	A
Inga densiflora Benth.	HyM	A	Guaba, Guaba de monte	A
Inga edulis Mart.	HyM	A	Guabo silvestre	A
Inga marginata Willd.	H	A	Guabillo	Ot
Inga thibaudiana DC.	M	A	Guaba silvestre	Aa
Ipomoea batatas (L.) Lam.	M	V	Camote	A
Iresine herbstii Hook.	M	H	"Hoja verde-blanca"	Or
Iriartea deltoidea Ruiz & Pav.	H	A	Pambil	Ma
Justicia pectoralis Jacq.	H	H	Contra del día	Me
Lantana camara L.	HyM	H	Sanguinaria	Me, Ot
Lantana sp.	M	Ab	Tupirosa	Or, Ot
Lycopodiella cernua (L.) Pic. Serm.	M	H	Helecho	Or
Mangifera indica L.	HyM	A	Mango	A
Manihot sp.	M	Ab	Yuca Amarilla	A
Manihot esculenta Crantz	HyM	H	Yuca	A
Marrubium vulgare L.	H	H	Amor seco	Me
Matisia soegengii Cuatrec.	HyM	A	Zapote de monte	A, M
Medicago sp.	M	H	Maní	A
Melia azedarach L.	M	A	Alelí	Or
Melissa officinalis L.	M	H	Toronjil	Me
Mentha pulegium L.	M	H	Menta	Me
Mentha spicata L.	M	H	Hierba buena	Me
Meriania aff *drakei* (Cong.) Wurdack	H	Ab	"Sin nombre"	M
Minthostachys sp.	HyM	H	Tipo	Me
Musa sp.	HyM	H	Banano, Plátano, orito	A
Myrcianthes sp.	H	Ab	Guayabillo	M
Naucleopsis sp.	H	A	Guión	M
Nectandra acutifolia (Ruiz & Pav.) Mez	HyM	A	Aguacatillo	M, Aa
Nectandra guadaripo Rohwer	H	A	Canelo vago	Ot
Nectandra purpurea (Ruiz & Pav.) Mez	H	A	Aguacatillo	M
Nectandra reticulata (Ruiz & Pav.) Mez	HyM	A	Aguacate de monte, Jigua,Yalde	M
Nicotiana tabacum L.	M	H	Tabaco	Ot
Ochroma pyramidale (Cav. ex Lam.) Urb.	M	A	Palo Balso	Or
Ocimum campechianum Mill.	M	H	Albaca	Me
Ocotea insularis (Meisn.) Mez	H	A	Mal de aire	Ot
Opuntia sp.	M	Ab	Cactus	Or
Opuntia ficus-indica (L.) Mill.	M	Ab	Penca	Or, Ot
Otoba gordoniifolia (A.DC.) A.H. Gentry	H	A	Sangre de gallina	M
Otoba gracilipes (A.C. Sm.) A.H. Gentry	H	A	Sangre de gallina	M,Aa
Pachystachys lutea Nees	M	Ab	Flor amarilla	Or
Paspalum dilatatum Poir.	HyM	H	Pasto miel	Aa
Paspalum fasciculatum Willd. ex Flüggé	HyM	H	Gramalote	As
Paspalum paniculatum L.	HyM	H	Limoncillo	Me,Aa
Passiflora sp.	M	V	Granadilla silvestre	A
Passiflora edulis Sims	M	V	Maracuyá	A
Passiflora maliformis L.	M	V	Granadilla de hueso	A
Passiflora montana Holm-Niels & Lawesson	HyM	V	Granadilla de hueso	A
Passiflora palenquensis Holm-Niels. & Lawesson	HyM	V	Granadilla	A
Pelargonium sp.	H	H	Chupana	Me
Pelargonium odoratissimum (L.) L'Hér.	M	H	Geránio	Or

Nombre científico	G	HA	Nombre común	Uso
Pennisetum purpureum Schumach.	HyM	H	Darliz, Puntero	Aa, Ot
Pentagonia cf. *grandiflora* Standl.	H	A	Canelo	M
Persea americana Mill.	HyM	A	Aguacate	A
Pfaffia aurata (Mart.) Borsch	M	Ab	Pilpe	Me, Ot
Phaseolus sp.	M	V	Fréjol tumbe	A
Philodendron verrucosum L. Mathieu ex Schott	M	He	Corazón morada	Or
Phyllanthus anisolobus Müll. Arg.	HyM	Ab	Barbasco	Ot
Pilea fasciata Weld.	H	H	"Sin nombre"	Me
Piper sp.	M	Ab	Cueche largo	Me
Piper aduncum L.	HyM	Ab	Cordoncillo, Cueche, Matico de monte	Me, MeA
Piper ottoniifolium C. DC.	H	Ab	Guabiluca	Me
Piper peltatum L.	HyM	Ab	Santa María	Me
Pitcairnia ferrell-ingramiae H. Luther & Dalström	H	H	Flor roja	Or, Ot
Plantago major L.	HyM	H	Llantén	Mr
Pourouma bicolor Mart.	H	A	Uva	M
Pouteria sp.	HyM	A	Caimito	M, Ot
Psammisia ulbrichiana Hoerold	H	Ab	Picaflor	Or
Psidium acutangulum DC.	H	A	Guabillo de hoja larga	M
Psidium guajava L.	H	Ab	Guayaba	A
Psychotria alleni Standl.	HyM	Ab	Nacedero	Ot
Psychotria pilosa Ruiz & Pav.	H	Ab	Nacedero	Me,MeA,Ot
Pteris podophylla Sw.	H	H	Helecho	A
Renealmia thyrsoidea (Ruiz & Pav.) Poepp. & Endl.	H	H	San Juanito	Me
*Rhynchospora watsonii (*Britton) Davidse	H	H	Coco	Aa
Rollinia andicola Maas & Westra	H	A	Anona	A
Rosa hibrida L.	M	Ab	Rosa	Or
Rubus adenotrichos Schltdl.	HyM	Ab	Mora de monte	Me
Rubus niveus Thunb.	HyM	Ab	Mora silvestre	A
Rubus urticifolius Poir.	HyM	Ab	Mora	A, Me
Ruta graveolens L.	HyM	Ab	Ruda	Me
Saccharum officinarum L.	HyM	H	Caña de azúcar	A, Or, Ot
Salvia alvajaca Oerst.	HyM	H	Albaca, Linaza	A, Me
Sansevieria cf. *trifasciata* Prain	M	H	Hoja larga	Or
Saurauia bullosa Wawra	HyM	Ab	Dalia, Moquillo	MeA
Saurauia cf. *tomentosa* (Kunth) Spreng.	H	A	Moquillo	A, Aa
Saurauia herthae Sleumer	H	Ab	Muquillo	A
Schizolobium parahyba (Vell.) S.F. Blake	M	A	Pachaco	Or
Senna reticulata (Willd.) H.S. Irwin & Barneby	H	Ab	"Flores amarillas redondas"	Or
Sida poeppigiana (K. Schum.) Fryxell	HyM	Ab	Escobillo	Me,Aa,Ot
Sloanea fragrans Rugby	H	A	Achotillo	M
Smilax sp.	H	L	Grillo	Ot
Smilax aff. *febrifuga* Kunth	H	L	Grillo Blanco	Ot, Me
Solanum aloysiifolium Dunal	H	H	Hierba Mora	Me
Solanum betaceum Cav.	HyM	A	Tomate de árbol	A
Solanum lycopersicum L.	M	H	Tomate de riñón	A
Solanum nigrescens M. Martesns & Galeotti	H	H	Hierba mora	MeA
Solanum quitoense Lam.	HyM	Ab	Naranjilla	A
Solenostemon sp.	M	H	Hoja morada	Or
Sorocea steinbachii C.C. Berg	H	Ab	"Sin nombre"	M
Stachytarpheta cayennensis (Rich.) Vahl	HyM	H	Rabo de ratón	Me
Swietenia macrophylla King	M	A	Caoba	M
Syngonium podophyllum Schott	M	He	Camote Morado	A,MeA
Tagetes erecta L.	M	H	Hierba de gallinazo	Or
Tapirira guianensis Aubl.	H	A	Cedrillo	M
Terminalia amazonia (J.F. Gmel.) Exell	H	A	Roble	M
Thelypteris hispidula (Decne.) C.F. Reed	HyM	H	Culantrillo, Culantro del monte	Ot

Nombre científico	G	HA	Nombre común	Uso
Theobroma cacao L.	M	A	Cacao	A
Tillandsia sp.	HyM	E	Vicundo	Or
Tithonia diversifolia (Hemsl.) A. Gray	HyM	H	Tres dedos	Me
Tradescantia zanonia (L.) Sw.	M	H	Pigua	Me
Trichilia cf *laxipaniculata* Cuatrec.	H	A	Chalde	M
Trichilia surinamensis (Miq.) C. DC.	H	A	Guabo	M
Triplaris americana L.	HyM	A	Cucharrillo	M
Turpinia occidentalis (Sw.) G. Don	H	A	Sabaleta silvestre	Ot
Urena lobata L.	HyM	Ab	Abrojo	Aa, Ot
Urera caracasana (Jacq.) Gaudich. ex Griseb.	M	Ab	Ortiguilla, Ortiga	Ot
Urtica sp.	M	H	Ortiga de monte, O. negra	Me
Verbena litoralis Kunth	HyM	H	Verbena	Me
Vernonia sp.	HyM	Ab	Díazmaco	Ot
Vetiveria zizanioides (L.) Nash	M	H	Pasto Vetiver	Aa
Virola elongata (Benth.) Warb.	HyM	A	Brazilargo	M, Aa
Xanthosoma sp.	HyM	H	Camacho	Or
Yucca cf *aloifolia* L.	M	A	"Sin nombre"	Or
Zanthoxylum riedelianum Engl.	H	A	Naranjuelo	M
Zea mays L.	M	H	Maíz, Morochillo	A

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TREE CANOPY RESEARCH AND STUDENT EXPERIENCES USING THE DOUBLED ROPE CLIMBING METHOD

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ABSTRACT

Students from the University of Central Missouri explored the tree canopies of the Great Smoky Mountains National Park in Tennessee and North Carolina, Daniel Boone National Forest in Kentucky, and Big Oak Tree State Park, Ha Ha Tonka State Park, and Pertle Springs in Missouri from the summer of 2000 to 2007. The Doubled Rope Climbing Method (DRCM) was used to climb more than 500 individual trees without injury. This included three vine species and also 49 tree species, usually exceeding 60 cm diameter at breast height, and more than 30 m in total height. Students attended a two-day mandatory tree climbing school held at Pertle Springs. The purpose of this paper is to provide information about how to obtain financial grant support and a detailed description of the DRCM and student research experiences represented by the Adventure Phase, the Laboratory Phase, and the Publication Phase. Advantages and disadvantages of the DRCM and hazards associated with climbing gear, study sites, and climbing trees are discussed in detail. The climbing gear and knots used in the DRCM are described and illustrated with color images along with the climbing procedure used to obtain bark samples, aerial reproductive structures, and cryptogams in vertical transects from near ground level to the treetop. The sampling protocol, student field experiences, discovery of a new myxomycete species (*Diachea arboricola*), tree canopy publications, media coverage, and outreach and education with seventh grade life science students at Warrensburg Middle School are included as examples of student professional scientific experiences. Multiple projects examined the occurrence and importance of cryptogams such as myxomycetes, macrofungi, mosses, liverworts, lichens, and ferns. Observations of invertebrates including insects, mollusks, nematodes, and tardigrades were also noted. Future directions for research using the DRCM are suggested in order to help the next generation of tree canopy biologists explore, ask questions, and develop hypotheses that will increase our knowledge of the biosphere.

RESUMEN

Estudiantes de la Universidad Central de Missouri exploraron doseles de árboles en el Parque Nacional "Great Smoky Mountains" en Tennessee y Carolina del Norte, Bosque Nacional "Daniel Boone" en Kentucky y Parque Estatal "Big Oak Tree," Parque Estatal "Ha Ha Tonka" y Pertle Springs en Missouri, desde el verano del 2000 al verano del 2007. El método de cuerda doble para escalar (MECD) se usó para subir a más de 500 árboles individuales (sitios de estudio) sin accidentes graves. Estos sitios de estudio incluyen 49 especies de árboles que generalmente exceden los 60 cm de diámetro a la altura del pecho y más de 30 m de la altura total y tres especies de enredaderas. Los estudiantes asistieron a una clase obligatoria para escalar árboles. El propósito de este trabajo es el de proveer información de como obtener ayuda financiera y una descripción detallada del MECD y las experiencias de investigaciones de los estudiantes representados por una Fase de Aventura, una Fase de Laboratorio, y una Fase de Publicación. Las ventajas y desventajas del MECD y riesgos asociados con el quipo de escalar, sitios de estudios, y árboles escalados son discutidos con todo detalle. El equipo de escalar y los nudos usados en el MECD son descritos e ilustrados en color junto con el procedimiento de escalada usado para colectar las muestras de cortezas, las estructuras reproductoras aéreas, y criptógamas en transectos verticales desde el nivel del suelo hasta la copa de los árboles. El protocolo del muestreo, las experiencias de campo, el descubrimiento de una nueva especie de myxomycete (*Diachea arboricola*), las publicaciones

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sobre doseles arbóreos, las coberturas periodísticas, y el alcance y educación con estudiantes de ciencias biológicas de séptimo grado del Colegio de Warrensburg son incluidos como ejemplos de oportunidades científicas profesionales estudiantiles. Este proyecto se centró en la ocurrencia y la importancia de criptógamas en su mayor parte como myxomycetes, macromicetos, musgos, hepáticas, líquenes, y helechos y observaciones de invertebrados incluidos insectos, moluscos, nematodos, y tardígrados. Direcciones futuras para la investigación usando el MECD son sugeridas para actividades investigadoras adicionales en los doseles de los árboles. Este trabajo ayudará a la próxima generación de biólogos en doseles de árboles a utilizar los métodos de conseguir acceso al dosel de árbol y para explorar, hacer preguntas, y desarrollar las hipótesis que aumentarán nuestro conocimiento de la biosfera.

KEY WORDS: cryptogams, doubled rope climbing method (DRCM), Great Smoky Mountains National Park, Tennessee and North Carolina, Daniel Boone National Forest, Kentucky, Pertle Springs, Missouri, myxomycetes, tree canopy, tree climbing

INTRODUCTION

This paper describes the climbing methodology, sampling protocol, and student research experiences used to survey and inventory tree canopy biodiversity in the Great Smoky Mountains National Park (GSMNP) of Tennessee and North Carolina, Daniel Boone National Forest (DBNF) in Kentucky, and Big Oak Tree State Park, Ha Ha Tonka State Park, and Pertle Springs in Missouri. This research project began the summer of 2000 and has included more than 20 undergraduate and master's degree level students at the University of Central Missouri (UCM).

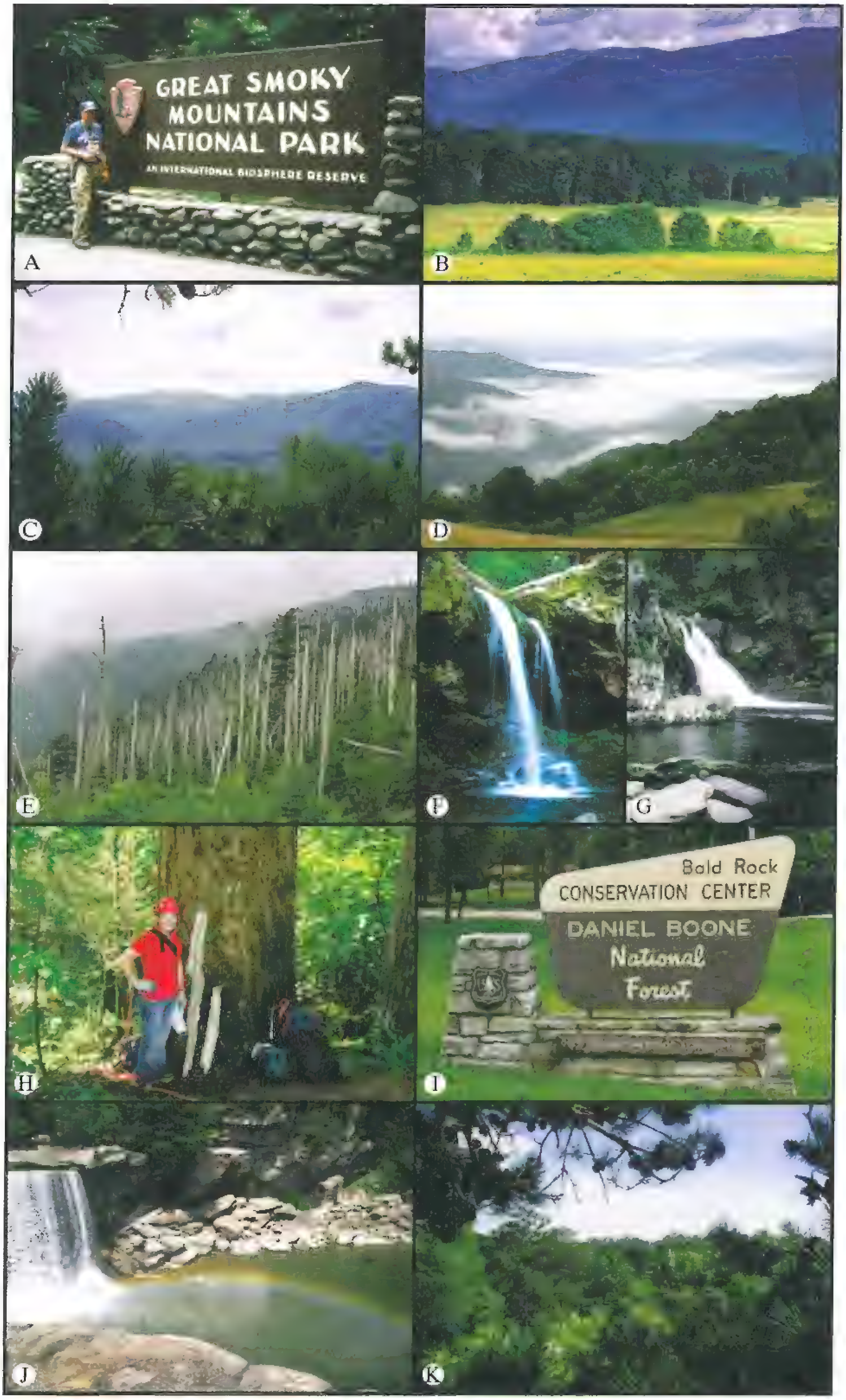
Landscape vistas in GSMNP make this the most popular national park with over 11 million visitors annually. Scenic mountains, waterfalls, valleys, and the mixed diversity of deciduous and evergreen trees highlight brilliant fall leaf colors, old growth forests host champion-size trees, and summer haze and storms create beautiful cloud fields in high elevation areas of the Park (Fig. 1A–H). Located just a short distance to the north of GSMNP, the DBNF in Kentucky has a rugged topography that features scenic land formations and waterfalls, especially at Cumberland Falls State Park (Fig. 1I–K).

The purpose of this paper is to provide information on how to obtain financial grant support and the additional narrative details and color images that document the terminology of climbing gear used to gain tree canopy access. Also provided are detailed descriptions of climbing trees using the Doubled Rope Climbing Method (DRCM), and a body of literature that describes tree canopy research in temperate forests. The field experiences designated here as the Adventure Phase used the DRCM to gain access to the tree canopy. The advantages of DRCM serve as an example of tree canopy access that will help others with planning and executing tree canopy exploration. Results are summarized and in some cases reported for the first time.

National Science Foundation Small Grant for Exploratory Research

This research project would not have been possible without the financial support of the National Science Foundation (NSF) Small Grant for Exploratory Research (SGER) through the Biodiversity Surveys and Inventories Program, Division of Environmental Biology. When applying for such a grant the appropriate Program Officer should be contacted to determine if the project proposal idea meets the specific SGER criteria, and in our case, the application of new expertise or new approaches to established research topics. Our research idea of accessing the tree canopy using the DRCM to explore and collect myxomycetes, macrofungi, lichens, liverworts, mosses, and ferns in the Great Smoky Mountains National Park (GSMNP) appeared to match

FIG. 1. A–H. Great Smoky Mountains National Park. A. Sign at the Gatlinburg, Tennessee entrance to the park. B. Cades Cove Valley is a low elevation open field site with mountain ridges on all sides. The Cades Cove Loop Road is a popular scenic drive for park visitors. Many trees were climbed in this area and resulted in the discovery of the new species, *Diachea arboricola*. C. Treetop view along Ridge Mountain Road overlooking Cades Cove. D. Panoramic view from the high altitude site at Purchase Knob and the Appalachian Highlands Science Learning Center. Cloud fields form in low areas after afternoon rain showers. E. Clingman's Dome, the highest point in Tennessee at 2,025 m, showing many dead spruce and Fraser fir trees caused by the Balsam wooly adelgid insect and aerial pollution. F. Grotto Falls located along the Roaring Fork Motor Nature Trail near Gatlinburg. G. Abrams Falls plunges 8 m into a large pool. One of the most popular sites in the park located off the Cades Cove Loop Road. H. Live, old growth, tulip poplar trees grow to tremendous size. Note the slabs of bark that fell while climbing this tree. I–K. Kentucky sites. I. Daniel Boone National Forest Bald Rock Conservation Center that was the source of *Pinus echinata* bark and cone samples obtained by limbwalking. J. Cumberland Falls plunges 21 m into the Cumberland River and forms a beautiful rainbow in the misty spray at the base shown here with full sunlight at midday. K. Panoramic view taken from the top of a *Pinus echinata* at the Holly Bay area DBNF.


GREAT SMOKY
MOUNTAINS
NATIONAL PARK
AN INTERNATIONAL BIOSPHERE RESERVE
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Bald Rock
CONSERVATION CENTER
DANIEL BOONE
National
Forest
H
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this criterion. We proposed to go where no one had gone before in the tree canopy at GSMNP and to make observations and collections of targeted groups of cryptogams (Keller 2005a, 2005b).

The program officer requested that HWK prepare a proposal, limited to five pages, entitled "SGER-RUI: Tree Canopy Biodiversity (myxomycetes, macrofungi, mosses, liverworts and lichens) in the Great Smoky Mountains National Park." Also included, was a clear statement of why this proposed research should be considered exploratory and high risk, and the significance of its potential impact on the discipline or field. It was important that the applicant work closely with the program officer since the SGER proposals undergo an internal merit review by NSF staff. In our case the draft narrative, budget details, and biographical sketch were previewed before submission by the NSF program officer. The maximum budget was $100,000, but the usual average amount was less for a project period of one to two years. Certain promising SGER projects approved by the program officer and division director may be extended for up to six additional months and supplemented with up to $50,000 in additional funding. Most of the budget supported student wages, climbing equipment and supplies, travel, and meals. In most cases lodging was provided by Discover Life in America in the GSMNP and the United States Forest Service in the DBNF.

METHODOLOGY

Methods to Access the Tree Canopy

Tree canopy exploration reached new heights in the 1970s with a variety of canopy access techniques modified from mountain climbing methods including the use of polyester ropes with a high tensile strength along with various ascenders (Nadkarni 1988; Lowman 1994; Nadkarni 1995; Lowman & Wittman 1996). Early canopy access usually resulted in a solo researcher climbing a tree using a method such as the single rope technique (SRT), cherry pickers, or ladders (Lowman 2004). The single rope technique was the first rope technique used to access the canopy in the 1970s (Lowman 1994; Lowman & Bouricius 1995; Lowman 2004). This method allows a researcher to sample a vertical transect into the canopy that can be replicated at other sites (Lowman & Wittman 1996; Lowman 1999). Rope studies with single climbers generally produce small data sets (Nakarni 1995). However, ropes can be used to attach structures in the canopy such as collapsible platforms used to observe arboreal vertebrates over a period of time. This allows multiple scientists to perch in the canopy and observe animal activity with minimal disturbance. The SRT cannot be used to access the upper branches in the canopy as noted by early arborists (Nadkarni 1988; Moffet & Lowman 1995).

Information about different methods of accessing the tree canopy are described in various books and journal articles as well as part of a lecture given by H. Bruce Rinker (2004) at a symposium entitled "Tree Canopy Biodiversity in the Great Smoky Mountains National Park" presented at the Mycological Society of America 2004 annual meeting held jointly with the North American Mycological Association. Chapter 1 by Moffett and Lowman (1995) includes tree canopy access techniques used for scientific studies, and Table I evaluates the different access methods assigning an assessment value from 1 (least desirable) to 10 (most desirable). The information contained in this table will help tree canopy biologists select the best access methods for their own special research projects. Updated progress in canopy walkway construction and canopy cranes is included in Chapters 23 and 25 (Lowman & Rinker 2004) and emphasizes how canopy access techniques will impact future sampling, hypotheses testing, and facilitate ecotourism in the tree canopy.

Ground based methods of canopy research are useful in collecting data for mobile or sensitive species and demanding projects such as insect surveys. In addition, radio telemetry can be used to study arboreal animals, colorful paint can be applied to arboreal reptiles, and arthropods can be collected *en masse* using insecticidal fogging (Moffet & Lowman 1995). Traps can be hoisted in the canopy using rope and pulley systems; for example, a team of researchers from UCM used "composite flight-intercept traps" (Fig. 2A) at Big Oak Tree State Park, Missouri to survey insect biodiversity (Wilson et al. 2003).

Recent canopy research favors a more collaborative approach and focuses on methods such as towers, canopy walkways, cranes, and the canopy raft and sled, all of which can accommodate several scientists at

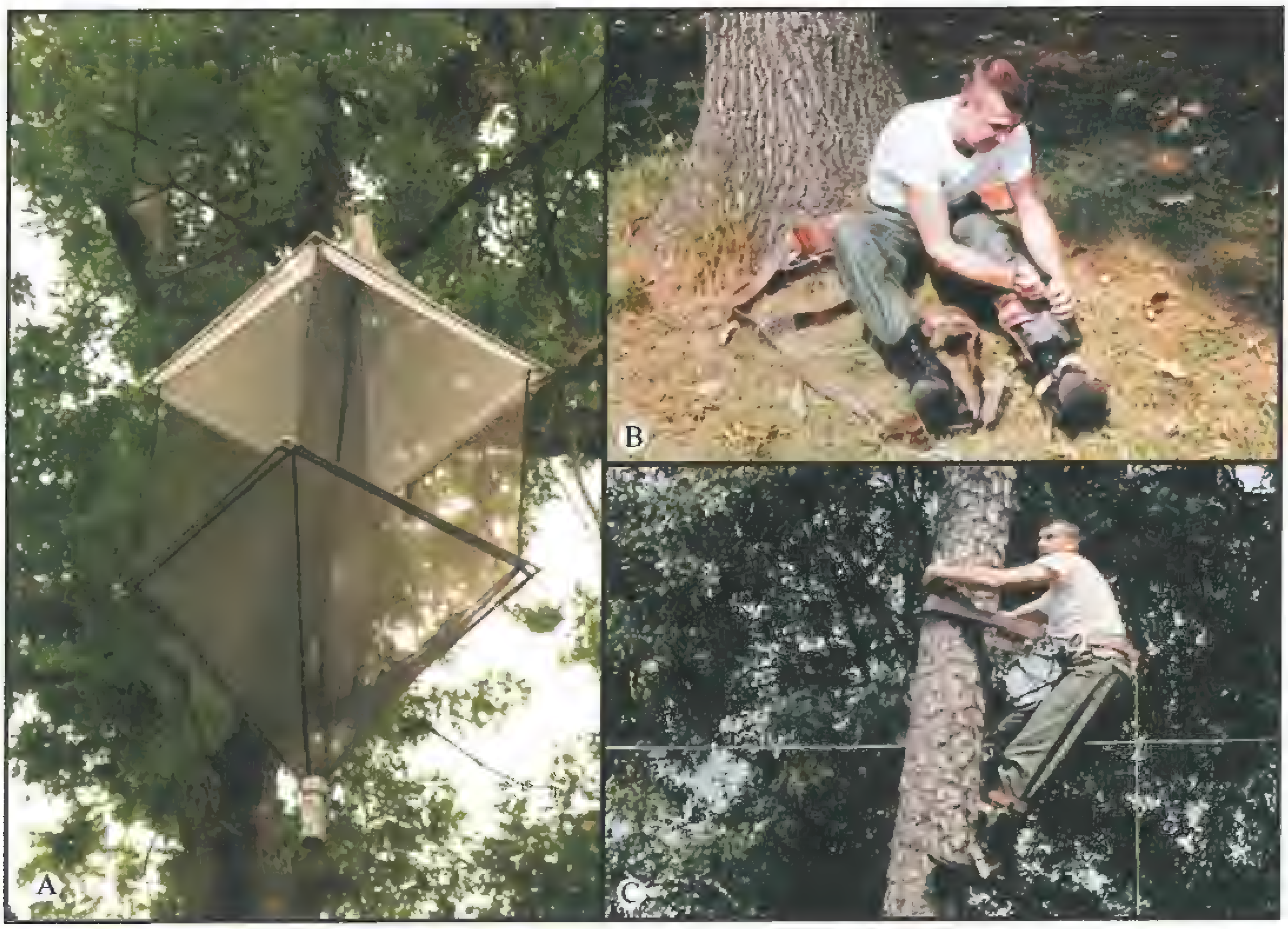

Fig. 2. A. Ropes are used to tether a flight intercept trap in the tree canopy. Note the white bottle at the top and bottom filled with alcohol. This trap can be lowered, the bottles unscrewed and insects removed, and then hoisted into the canopy again. Flying insects that hit the trap netting such as Coleoptera (beetles) fold their wings and tend to fall or crawl downward into the bottle at the bottom; other insects such as Lepidoptera (moths and butterflies) and Diptera (flies) tend to fly or crawl upward into the top bottle. B. Climbing spur unit strapped to the left leg with sharp spur along the inside instep of the boot with the other spur unit unstrapped on the ground. The waist belt unbuckled at base of tree. C. Pole climbing spurs and waist belt used to climb *Pinus taeda* L. This technique is used by telephone lineman on wooden poles, loggers, and tree service arborists. The spurs penetrate deeply enough to injure the tree. Federal and state collecting permits require a detailed description of the climbing method and climbing spurs are banned. Note the power line in the background. Photograph taken circa 1966, Atlanta, Georgia.

a time (Lowman 2004). These methods usually sample from the outer limbs or periphery of the tree, not the trunks, whereas rope climbing allows the researcher to be in direct contact with the trunk of the tree. Towers represent a permanent structure for canopy research; however, few trees are within reach from a single point. Canopy walkways and cranes are attached to towers and provide a larger sample area (Lowman 1994). Canopy walkways are often more affordable than cranes, which cost between one and five million dollars (Lowman 2004), and are often used for ecotourism and conservation (Lowman & Bouricius 1995; Lowman et al. 2002). The canopy raft is of French design and effectively creates a platform lifted by a dirigible to the treetop canopy from which scientists can study the canopy/atmosphere interface (Lowman 1994; Nadkarni 1995; Lowman & Wittman 1996; Lowman et al. 2002; Lowman 2004). A smaller raft that is trailed behind the dirigible, called a sled, is used to skim the canopy allowing scientists to collect leaves, epiphytes, various flowers and their pollinators (Lowman 1994; Nadkarni 1995; Lowman & Wittman 1996; Lowman et al. 2002; Lowman 2004). Other more daring methods of cooperative canopy exploration include ultralight planes (Lowman & Wittman 1996).

Methods to access the tree canopy have not generally complied with Occupational Safety and Health Administration (OSHA) regulations (Grushka et al. 1999). A team of researchers developed the first OSHA regulated fall arrestance canopy access system to be used by scientists at the University of Columbia Biosphere 2 Center for Research and Education in Oracle, Arizona (Grushka et al. 1999). Although risky, canopy research is essential as biologists race to survey species in dwindling forests worldwide. It is estimated that over half of the world's species of plants and animals occur in the tree canopies (Nadkarni 1995; Lowman 2004). Canopies also play an integral role in nutrient cycling, are a major source for photosynthesis, and serve as a carbon sink for atmospheric CO_2 (Lowman 1994; Lowman & Wittman 1996; Lowman 2004).

Canopy access methods should be considered when creating a research project. Studies can involve sessile organisms, mobile organisms, or interactions of sessile and mobile species within the tree (Lowman 1999, Lowman 2004). Sessile organisms such as epiphytes that grow along the trunk and inner branches of the tree are the easiest to study with rope methods in the canopy and represent fewer logistical constraints. However, certain plant organs such as flowers and buds produced on the tips of branches and uppermost branches of the canopy are more difficult to reach with rope climbing methods and would therefore be better sampled using a crane, walkway, or raft (Lowman 2004). Another way to access mature, aerial reproductive structures (cones and dried fruits) on branches in the outer tree canopy used limb walking with the DRCM (Kilgore 2008).

Tree canopy access is possible using dirigibles, cranes with gondolas, cherry pickers, elevated platforms or walkways, inflatable platforms, peconha, tree houses or bridges, ladders, towers, boats, sleds, pole climbing spurs and belt (Fig. 2B,C), free hand or rope climbing methods. Even so, the current literature does not include a detailed discussion of the advantages and disadvantages of the DRCM, as a useful method for conducting canopy research, the description and use of the climbing equipment (ropes, climbing saddles, knots), safety precautions as these apply to tree canopy survey research, and a stepwise "how to" approach of the climbing methodology. Previous publications include general information about the DRCM (Snell & Keller 2003; Keller et al 2003; Keller 2004a, 2004b, 2005a; Everhart & Keller 2008; Everhart et al. 2008; Kilgore 2008) used mostly in the GSMNP.

Requirements for Climbing and the Tree Climbing School

Selection of student tree climbers first involved national recruitment efforts including posting announcements in national newsletters, on our web site: http://faculty.ucmo.edu/myxo/, on electronic bulletin boards, and making announcements at regional and national professional scientific meetings such as the Association of Southeastern Biologists and Mycological Society of America annual meetings. Local recruitment efforts involved displaying flyers and posters in university hallways showing rope climbing images and scenic color images from past field experiences, presenting departmental seminars, and delivering announcements in biology classes. Three phases of this research project were repeatedly emphasized; the Adventure Phase (tree climbing and sampling); the Laboratory Phase (sample sorting and moist chamber cultures); and Publication Phase (poster and oral platform presentations along with abstracts, team written articles for newsletters, or refereed journal papers based on individual student research projects).

Prospective students were interviewed to determine their interest and qualifications to complete all three phases of the tree canopy biodiversity research project. A student profile included the following information: field experiences such as hiking, backpacking, and camping in remote areas; athletic activities that involved team sports or activities, strength building exercises, repelling, rock or wall climbing, and tree climbing using rope systems; academic major (biology preference), undergraduate classes, grade point average, and biology courses completed; skill sets including use of computer software, database spreadsheets, microscopes, digital cameras, use of topographical maps, and global positioning systems; future career interests, and especially interest in graduate school. Strength building exercises to increase upper body arm strength and body form were important in successfully reaching upper parts of the tree canopy. Students with research projects already planned in advance that included tree and vine species targeted for sampling were more successful in the Publication Phase.

Each qualified student was required to sign a Release and Acknowledgment of Risks Agreement prior to attending the tree climbing school. This document described the risks involved in travel to, from, and

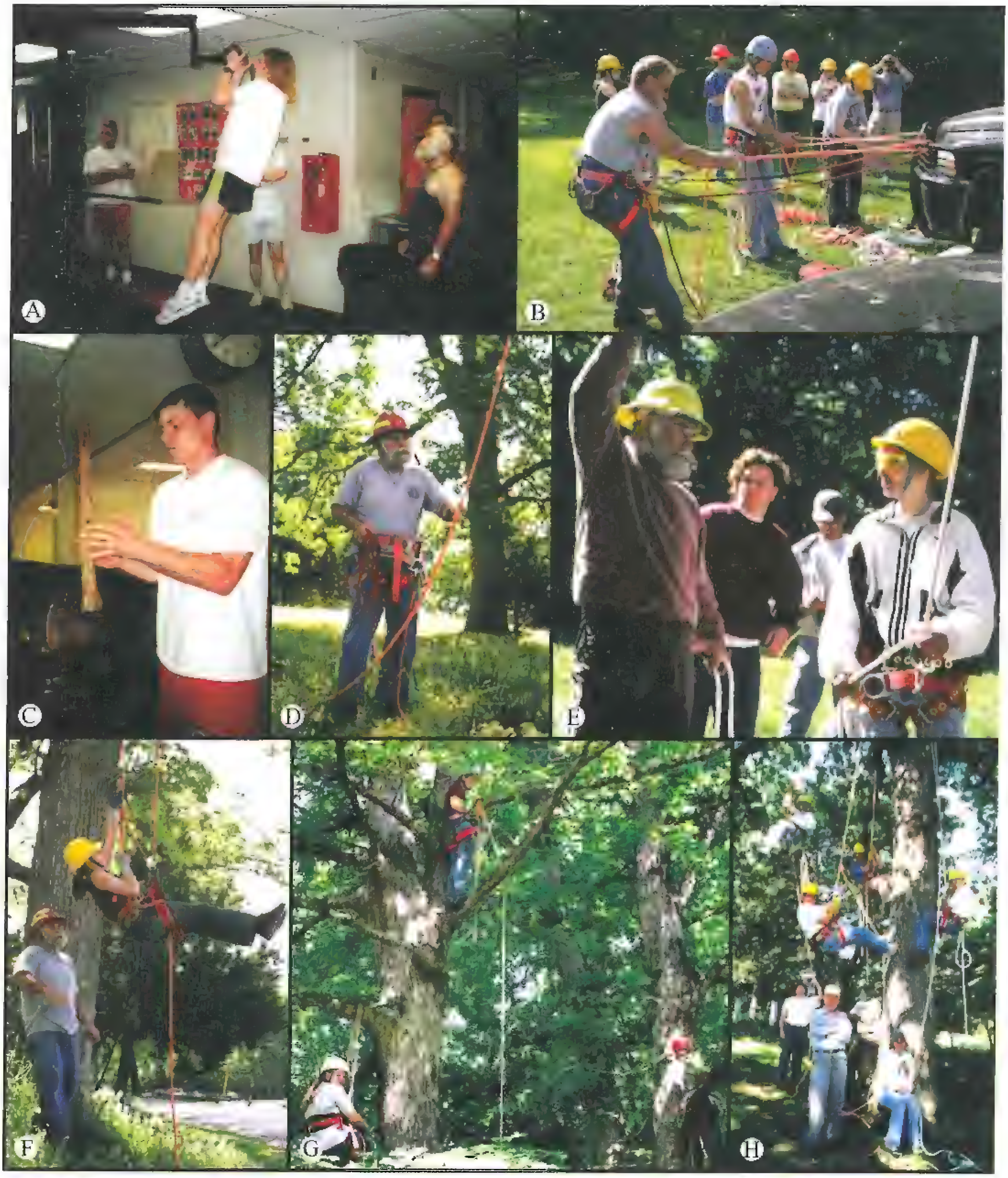

FIG. 3. Tree climbing school. A. Exercises included repetitive pullups to increase arm strength. B. Rope practice session at Pertle Springs using the Anchor Hitch to tie in to saddle and the Blake's Hitch tied to the climbing rope with the split tail. C. Finger walking an axe handle to strengthen fingers for grasping the climbing rope. D. Climbing instructor Charly Pottorff demonstrating the butterfly saddle with climbing rope tied into carabiner. E. Students practice tying the climbing rope into the climbing saddle. F. Instructor supervising climber using the DRCM and arm strength to ascend the climbing rope freely suspended. G. Three climbers in two trees. Left foreground climber resting in saddle attached by lanyard to limb, climber above standing on limb, climber in adjacent tree in resting position. This helps climbers adapt to different tree heights and builds confidence in the climbing equipment. H. A group picture of climbers from the first tree climbing school held at Pertle Springs the spring of 2000 "hanging out" in the tree with instructor and ground crew at base.

within forested areas, hiking in remote areas, dangers such as stinging insects, wild animals, poison ivy, and using ropes to climb trees. In addition, each student was required to be more than 18 years of age and have medical insurance. Contact information was provided in case of medical emergency. Additional optional information included any physical condition that might increase the risk of being in the field for prolonged periods of time, and the endurance required to hike long distances and climb trees. Emphasis was given to team sports and cooperative activities since the Adventure Phase was a team effort that required living and working in close quarters. We had a minimum of 4 to 8 participants in the Adventure Phase for the GSMNP and DBNF field trips.

A two-day tree climbing school was held in late April or early May at Pertle Springs, Warrensburg, Missouri (Fig. 3A–H). Charly Pottorff, a professional arborist from Manhattan, Kansas, was the first tree climbing instructor (Fig. 3A,D,E,F,H). He has been a professional arborist since 1968 and also a member of the Kansas Arborist Association and International Society of Arboriculture. His involvement for many years in popular regional Tree Climbing Jamboree competitions as an organizer, convener, and practitioner of rope climbing techniques has resulted in being on the cutting edge of climbing techniques and equipment design and safety. The combination of his physical exercise routines and tree climbing expertise allowed him to serve as a role model for the next generation of tree canopy climbers.

Instructors led training sessions that were intense and physically demanding to ensure that each student climber had developed the physical strength and conditioning to safely climb 30 m or more into the tree canopy. This included a series of exercises that helped build upper body strength. Indoor exercises included: pull ups with palms up or down on the bar, cliff hangers with hands facing one another with palms on the bar (Fig. 3A), finger tip push ups, leg lifts, and the sledge hammer – an axe handle finger walk (Fig. 3C) that increases finger strength. Outdoors everyone ran stadium steps to increase endurance and leg strength. Rope climbing practice at Pertle Springs included using the climbing equipment and gear (knot tying Fig. 3B,) and demonstrations by the instructors (Figs. 3D,E; 7A,E). Climbers were supervised by the instructor on their first climbing attempt (Fig. 3F). Once in the tree canopy, climbers practiced using lanyards, knots used in advancing, relaxing in the saddle, and standing on a branch to rest and adapt to the canopy height (Fig. 3G). A group picture was taken at the completion of the tree climbing school (Fig. 3H). Only the students who successfully completed the training course on the basic DRCM were considered for the project.

The Adventure Phase, Laboratory Phase, and Publication Phase had to be satisfactorily completed to meet the objectives of this project (Counts et al. 2001; Keller & Skrabal 2002; Keller et al. 2002; Snell 2002; Keller & Snell 2002a; Keller & Snell 2002b; Snell & Keller 2001; Snell & Keller 2003). Each student kept a daily journal of observations that in some cases were used in research papers. Students were given writing assignments as part of team-writing projects. These narratives were collated into popular articles published in different newsletters (Counts et al. 2000; Henley et al. 2000; Keller & Skrabal 2002; Keller et al. 2002; Skrabal et al. 2001; Keller & Everhart 2007; Kilgore 2007; Kilgore & Keller 2007; Keller et al. 2008; Kilgore & Keller 2008).

Advantages and Disadvantages of the Doubled Rope Climbing Method (DRCM)

The two basic rope climbing systems most often used are the single and doubled rope methods (Jepson 2000). Advantages and disadvantages are associated with both techniques. Advantages of the single rope technique (SRT) include quick canopy access because the rope can pass over several tree crotches without impeding climbing, and it is safe and efficient when practiced correctly using back-up ascenders and descending devices (Dunlap 2002). A disadvantage of SRT is that the climber cannot advance higher in the canopy by advancing the rope from the original installation point. The climber can only advance if a separate climbing line is used (Jepson 2000). Another disadvantage of SRT is that several pieces of equipment are needed, including ascenders, pulleys, and stir-ups, which are a more mechanized mode of ascending into the tree canopy. If any of these mechanical devices are lost the climber cannot complete the climb (Charly Potorff, pers. comm.).

An advantage of using the DRCM for canopy research in the backcountry is that the necessary equip-

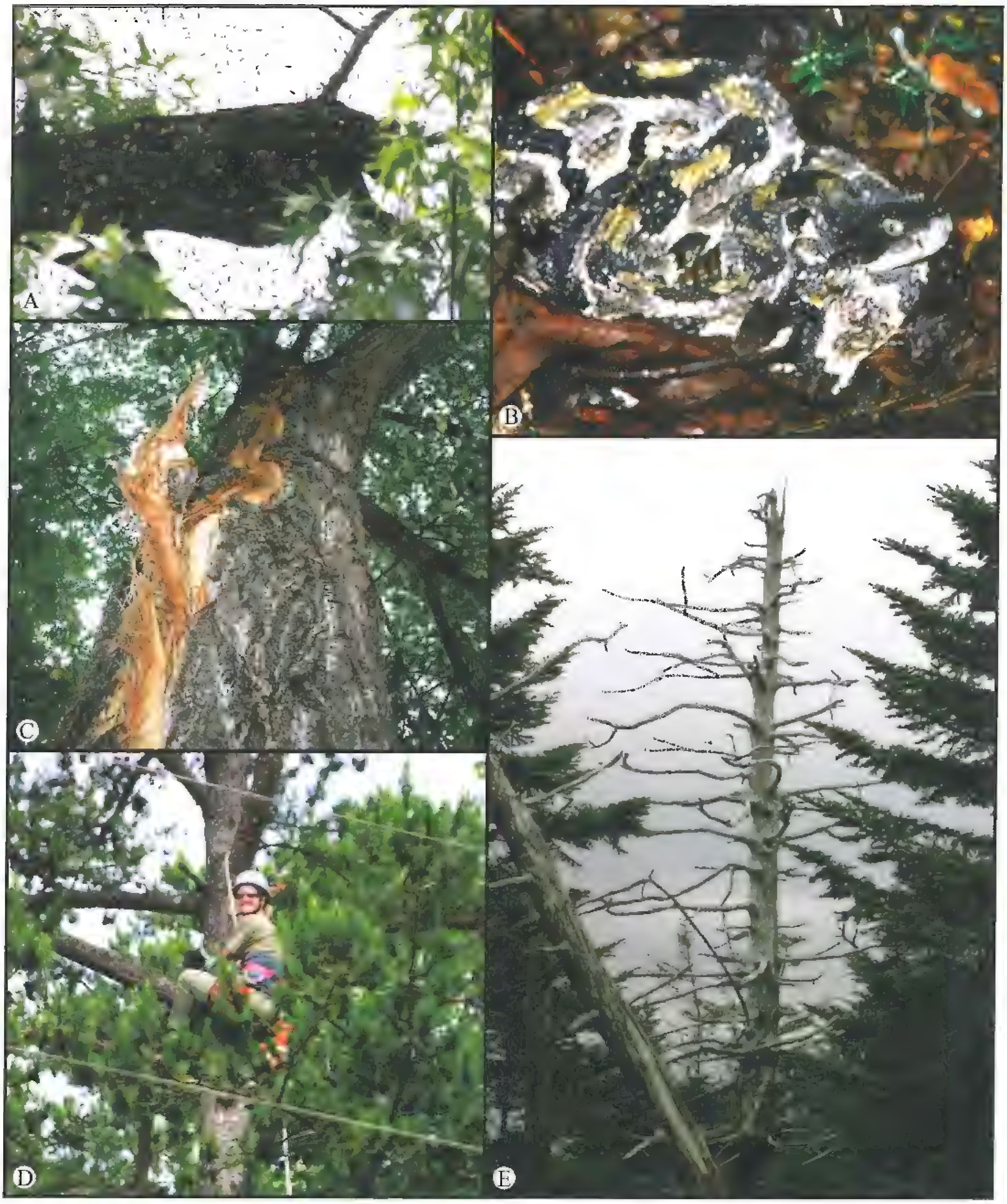

Fig. 4. Tree climbing hazards A. Tree holes and crotches may house bees with a bee swarm shown here. Binoculars are needed to ensure that bees are not in the pathway of the climber. B. A timber rattlesnake coiled with the dark brown rattles behind the head. This venomous snake was seen in GSMNP near our climbing tree site on a cold, misty day. C. Lightning strikes may damage, split, weaken, or kill parts of the tree and represent a potential danger at tree climbing sites. D. Electrical power lines shown here in the foreground pose a special threat when shooting the throwbag. E. Standing dead snag located in the spruce-Fraser fir high elevation zone near Clingman's Dome, the highest point in GSMNP. Our climbing protocol excluded trees that were dead, dying, or with large dead branches and this often included champion-sized trees.

ment is minimal so that each climber can pack the entire set of climbing gear into a standard backpack. The use of additional equipment such as ascending and descending devices is optional (Adams 2007a; Adams 2007b). To minimize the necessary climbing equipment, it is recommended that the climber rely on the climbing rope, split tail, safety rope, and his or her knowledge of the proper climbing knots used to access the tree canopy. This provides more mobility when hiking over long distances and allows quick use at specific sites. In addition, the DRCM is a non-invasive method that allows the climber to advance the rope to higher branches, often reaching near the top of the tree (Keller 2004a). The DRCM requires more strength than the SRT and climbers must be in top physical condition to successfully master this technique. Some researchers may see this as a disadvantage and a hindrance to completing tree canopy research in the backcountry. However, it is never a disadvantage to be in good physical condition when conducting tree canopy research in the backcountry and using DRCM was an incentive for the students to be in excellent health and develop athletic skills.

An advantage for both rope methods is that they are more affordable than other methods such as canopy walkways, towers, or cranes (Moffett & Lowman 1995). Ropes are also easily transported to different study sites, allowing researchers to sample from trees that are geographically separated rather than grouped together as in walkways, towers, or cranes; however, several research climbers are needed to sample a large number of trees.

Tree Climbing Hazards

Hazards to climbers can be avoided with pre-climbing safety inspections (Fig. 4A–E). Jepson (2000) includes an entire chapter on pre-climbing safety inspections. Safety inspections should be done on equipment, the climbing site, and the tree. Possible hazards in the equipment include frayed ropes or lanyards, inconsistent diameter of ropes, heat damage on ropes or lanyards, unsealed rope ends, cracks in safety helmets or eye protection gear, holes in gloves and clothing, tears or broken stitching in the climbing saddle, elongated holes in the climbing saddle waist buckle, and cracks or distortion in D-rings or carabiners that do not lock properly. Climbing gear should be free of dirt and debris to avoid jamming carabiners and possible loosening of knots.

Each study site must be inspected for animal activity, such as bees in the trees (Fig. 4A) hornet nests in the ground, venomous snakes (Fig. 4B), and also bear activity, wild pigs, raccoons, and possibly mountain lions. When climbing in the mountains, it was important to be aware of terrain by looking for steep slopes, boulders, loose rocks, landslide areas, and mountain creeks. Poisonous plants are often common on disturbed sites, so the climber must know how to identify poison ivy, poison oak, poison sumac, and stinging nettle.

Stormy weather and lightning pose serious hazards. Lightning is a deadly threat when working in the tree canopy (Fig. 4C). Weather forecasts in the GSMNP were unreliable since they were not specific to any particular region of the park. It frequently rains heavily in one part of the park with little or no rain in other parts. At lower elevations, movement of storms can be observed at fairly long distances. This allowed the climber sufficient time to complete work and exit the tree safely. Higher altitudes made it difficult to tell exactly how far away a potential storm was located. Furthermore, rain is also a hazard because wet ropes are more likely to slip, tightening knots and making ascension more difficult. Wet branches reduce traction, making it more difficult to climb into and advance within the tree. Ground sites become wet and slippery, increasing the chance that a climber would fall. Climbing before, during, and after thunderstorms and rain should be avoided.

Climbers should be aware of any electrical hazards such as power lines and grounded electrical lines (Fig. 4D). Septic systems and drain fields should also be avoided. The climber should be careful not to launch the throwbag over a limb in the direction of any vehicles, buildings, or people. Hikers and bystanders should be kept away from the climbing area, however, public curiosity and education were encouraged, so if a hiker came into the area, all team members stopped work for the moment to explain our activities and recommend a safe distance for viewing.

The climbing tree also poses potential hazards to the climber. These include signs of damage such as lightning damage on the trunk (Fig. 4C), broken limbs, dead trees and branches (Fig. 4E,) cavities at the base of the tree, poison ivy, thorns, honey bees in cavities, presence of wood rotting fungi, and loose bark (Fig. 1H). When foliage is dense in the canopy, broken limbs may not be visible. Binoculars help locate hard to see hazards, especially dead branches or damaged sections of the tree. Prior to climbing, the climber tests the sturdiness and integrity of the limb. If the limb bends or makes a noise indicating it is damaged, the limb should be avoided.

Tree Climbing Equipment and Gear

The Big Shot.—The Big Shot is an oversized slingshot that has a 2.4 m metal pole with a rubber gripper attached to the bottom end and a detachable head consisting of a forked metal frame on the top end. Attached to each end of the forked head are two strands of durable elastic rubber tubing that are joined in the middle with a sling that cradles the throw bag, similar to a slingshot. This metal pole can be separated into two 1.2 m sections that can be tied and carried on top of the backpack and assembled on site when ready to use (Fig. 5A,B). The Big Shot is used to launch the throwbag with the throwline over the desired climbing limb, thereby allowing climbing ropes to be installed in the upper canopy.

Throwbags.—Throwbags are made of thick woven material or leather, double stitched at the seams and filled with non-lead-based pellets. Throwbags usually come in two shapes: a tightly filled, aerodynamic torpedo-shape, and a partially filled tear-drop-shape for maneuvering through narrow crotches or inclined branches. Throwbags should be inspected before use to make sure the stitched seams have not broken. A metal O-ring is located at one end for throwline attachment. Throwbags weigh 227 g, 340 g, 397 g, or 454 g and each weight was able to reach different heights in the tree (Fig. 5D). The lightweight throwbags (227 g) were used more frequently by female tree climbers, reaching heights up to 25 m.

Throwline.—The throwline (also called slickline) is a small-diameter (approximately 1.75 mm), lightweight line that is yellow or multicolored (Fig. 5B; 6J; 7A–D) and is designed to be the first line installed in the tree. The throwline is tied to the throwbag O-ring with an Anchor Hitch knot that is dressed so no protruding ends wedge in crotches or hook on branches. A cloth storage bag approximately 14 cm deep and 10 cm wide is used to store the throwline to keep it from tangling. One end of the throwline is attached to the bottom of the storage bag and the other end is attached to the throwbag. Usually a throwline of 60 m is used, which means the shooter can reach a tree crotch or limb about 30 m high. Continual usage of the throwline often results in kinks that must be removed by tying and stretching the line between two trees. The ends of the throwline often frayed and this was fixed by melting the ends using a match or butane lighter.

Climbing ropes.—Ropes are available in different colors and lengths (Fig. 5A,B). Climbing ropes of 36 m in length are coiled in about 1 m lengths and a gasket hitch knot used to keep the rope from uncoiling (Fig. 6L). Once installed, the rope is limited to 18 m in height since it is doubled over a branch or crotch. Climbing ropes are a bright orange or a white color, 16 stranded, 1.3 cm diameter, with a tensile strength of 3,175 kg. One end has a spliced "eye" so a carabiner could be used to "tie in" (Fig. 6J) instead of tying a knot to the climbing saddle O-ring. The other end of the climbing rope has spliced ends with whipped twine to prevent the ends from fraying (Fig. 6A). Another white rope 60 m in length is used to reach a total height of 30 m after installation over a branch. The objective is to get the climbing rope installed at the highest possible point so advancing higher in the tree canopy takes less time. Split tails were approximately 1.5 m to 2 m long and were made the same as the climbing ropes (Fig. 5A).

Ropes are the climbers' lifeline and must meet minimum Occupational Safety and Health Administration standards that include abrasion resistance and a minimum breaking strength (dry test) of 2,449 kg. Ropes should be inspected before use to make sure that possible weakness due to abrasion, cuts from knife use or sharp bark edges, and accumulation of dirt have not weakened the rope and increased the risk of breakage.

Climbing saddles.—Two types of climbing saddles are used by students, the leather and butterfly. Leather

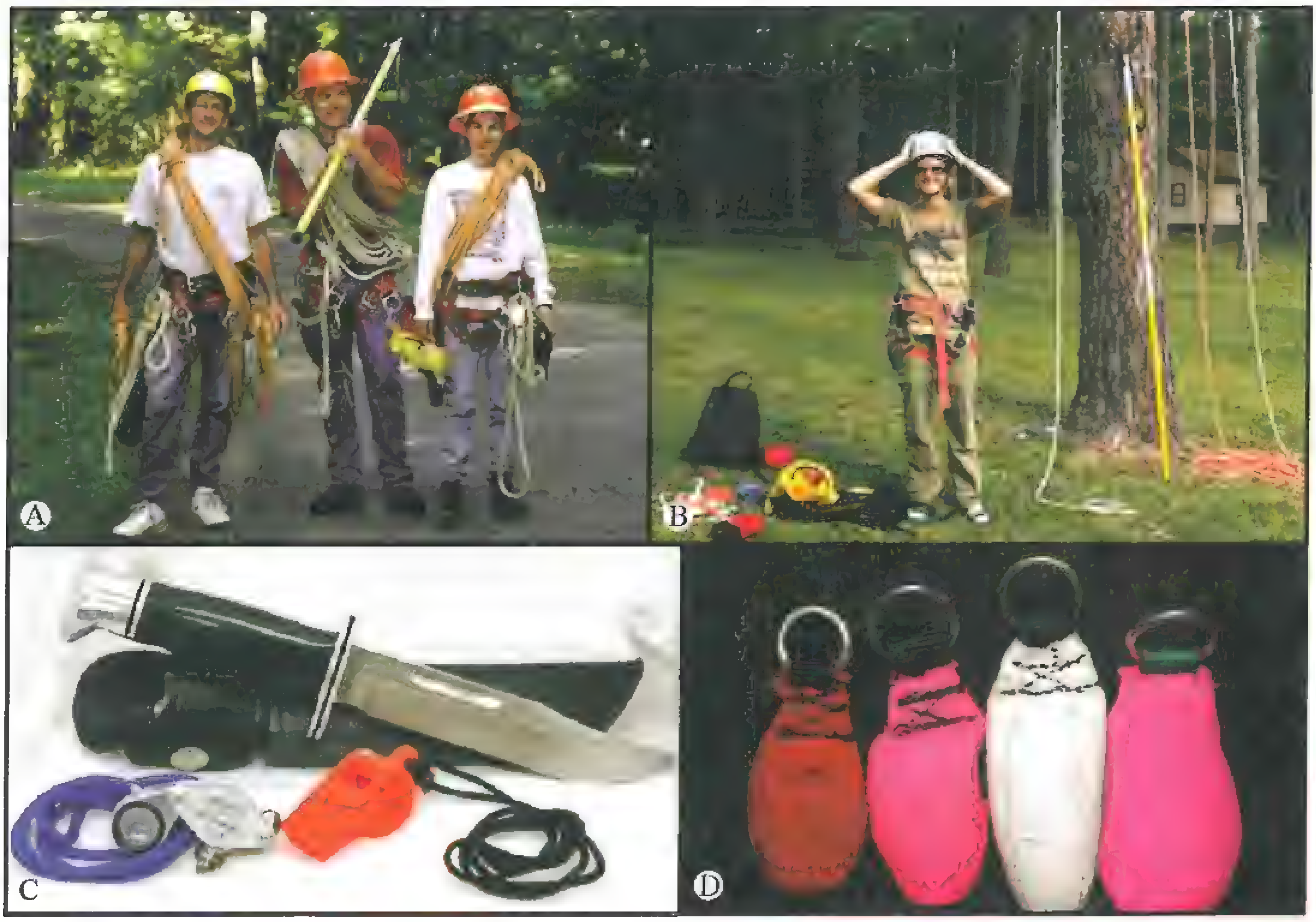

Fig. 5. A. Climbers with collecting and tree climbing gear. Note hard hat with brim, Big Shot, climbing ropes over shoulders, and leather climbing saddles with lanyards attached at their side. Climber at far left with split tail in right hand, storage bag for throwline and elevation line on right side. Climber in middle with Big Shot over shoulder and knife in sheath attached to right side. Climber at far right with elevation line in right hand and lanyard attached to saddle on right side. B. Climber with brimless helmet, Big Shot propped against trunk of tree, two climbing ropes in tree, backpack and throwline left, and altitude line foreground. C. Collection items carried by climber included heavy bladed knife and sheath to collect bark samples, a 20× handlens with attached blue lanyard to scan bark surface for myxomycetes, and whistle to communicate with ground crew and other climbers. D. Throwbags arranged from left the lightest to right the heaviest: 227 g, 340 g, 397 g, and 454 g. Note metal O-ring at top for throwline attachment, the leather, torpedo-shaped bag second from right, and the other three teardrop-shaped, cloth bags.

saddles have an extra wide 15.2 cm back support that is foam filled and incased in soft brown leather (Fig. 3E,F). The saddle can be adjusted to the waist and padded leg straps adjusted to the thighs with buckles. The leg straps of this saddle are sometimes uncomfortable in the groin region after prolonged periods in the tree canopy. Each saddle has two D-rings for carabiners or to tie the climbing rope and split tail, two O-rings for lanyard attachment, and also two snaps for equipment such as a knife for removing bark samples, a reel bound tape for height measurements, storage bag for throwbags and throwlines, and water bottles. Leather saddles weigh approximately 3.2 kg and increase the weight carried in the backpack.

The butterfly saddle is lighter weight at approximately 1.8 kg and is easier to carry (Fig. 3B,D,G; 5B; 7F–I,K,L). The padded backrest is 18 cm in height giving back support to the climber when in the saddle for longer periods of time. The belt and leg loops buckle with a smooth-action quick release. This saddle has two D-rings, two small O-rings and three cloth attachment loops on the back rest. Female student climbers prefer the butterfly saddle because it is more comfortable.

Each saddle provides freedom of movement in a horizontal or upside down position that relaxed tired legs. Both hands were free to handle a heavy-bladed knife to collect bark samples, or to use a 20X hand lens to scan the surface of the bark, or use a whistle to communicate with other climbers and the ground crew (Fig. 5C).

Lanyards (safety ropes).—This personal safety rope is used as an additional "tie in" while gathering bark samples or as a single tie in when advancing the climbing rope higher in the tree (Fig. 5A; 7F–I, K,L). Lanyards consist of a thick rope, connecting devices on each end with carabiners or a rope snap, and a lanyard adjuster to tighten the rope around the tree trunk. Sometimes it is difficult to secure the lanyard because of the large diameter of the tree trunk. Climbers usually use their legs to pull themselves as close to the tree trunk as possible and swing the rope around the trunk, catching the opposite snap end with their feet. The lanyard snaps are attached to the two D-rings on the climbing saddle or to carabiners.

Head gear.—Several types of head gear are worn, but clearly the best is a form fitting helmet without a brim or edge. Brightly colored red, blue, orange, or white helmets make it easy to track the climber high in the tree canopy, especially when thick foliage obscures the view from ground level. A helmet is worn by both the climber and ground crew members. Helmets protect the climber from falling objects such as debris from limbs, falling tree bark, and branches. Chunks of bark sometimes fall from above the climber, especially in old growth champion-sized trees, and the combination of gravity and height can result in serious injury to anyone underneath. Special tree climbing helmets made of durable hard plastic that is lightweight (approximately 0.5 kg) with an inner padded lining feature an external chin strap to prevent the helmet from becoming detached. Ventilation holes along the side prevent excessive sweating around the head band. Sometimes a bandana is worn to prevent slippage of the helmet (Fig. 5A,B; 7F–I,K).

Gloves.—The climbers must wear gloves to protect their hands from rope burn, to assure a firm grip on the climbing rope, to prevent scratches from sharp edges of bark, and to protect fingers when using a sharp-bladed knife when collecting bark samples. The palm is made of a latex coated, rubberized, and roughened surface and the backside from breathable cotton and polyester fibers (Fig. 6G–I; 7C,D,F,H,I,L).

Knots used in the Doubled Rope Climbing Method

Six basic knots are used: the Anchor Hitch, Figure Eight stopper knot, Blake's Hitch, Half Hitch, Monkey Fist, and Gasket Hitch (Fig. 6A–L). These knots, except the Half Hitch, are described in detail with illustrations in Jepson (2000). Toss (1990) presents an excellent, illustrated guide to tying knots. The website, http://www.iwillknot.com, gives animated examples of how to tie various knots and serves as a valuable resource for novice knot tyers (Hudson 2008).

Anchor Hitch.—This attachment knot is used to secure the throwline to the throwbag (Fig. 6A–C). It can also be used to tie one end of the rope to the D-ring or a carabiner on the climbing saddle if the climbing rope lacks an eye splice. This knot must be finished with a Figure Eight stopper knot to ensure that no creeping occurs. Creeping is the term used when the rope slowly moves through the knot, eventually untying the knot.

Figure Eight.—This attachment knot is a type of stopper knot (Fig. 6D–F) used as an added safety measure for the climbers to prevent the climbing rope from creeping through the attachment hitches, such as the Anchor Hitch and Blake's Hitch (Fig. 6C,F). This knot is easy to tie and resembles a figure eight when tied correctly.

Blake's Hitch.—This knot is a type of friction hitch, also known as a climbing hitch (Fig. 6G–I) and serves to grab the rope when it is under tension. When tension is lessened, the hitch can be moved up or down the rope. The Blake's Hitch knot is a variation of the Tautline Hitch, but is considered to move more smoothly on the rope with less friction to the climbing rope, making it more desirable as a climbing knot. The Tautline Hitch is also notorious for creeping and also binds and tightens to the rope, requiring frequent adjustments during climbing. Although the Blake's Hitch is more tedious to tie than the Tautline Hitch, it is a more functional climbing knot. A Figure Eight stopper knot is always tied to the tail of the Blake's Hitch to prevent any creeping (Fig.6F).

Half Hitch.—This knot is used to attach the throwline to the climbing rope before hauling the climbing line over the limb. Four or five Half Hitches are tied to one end of the climbing rope and will tighten when the throwline is pulled (Fig. 6J). Most importantly, they do not interfere with the climbing rope sliding over the crotch of a limb.

***Monkey Fist.*—**This knot is considered a type of throw knot (Fig. 6K). It is used for throwing one end of the climbing rope over a limb when advancing in the canopy. Throwing this knot works best when the climber is advancing short distances in the canopy. It can be tedious and awkward to throw, as the climber is usually forced to throw the knot straight overhead. Once the knot has successfully passed over the limb it unravels sending the rope back to the climber. If the Monkey Fist knot is unsuccessful, the climber may opt to use a throwbag attached to the throwline to gain access to the upper limbs in the canopy.

***Gasket Hitch.*—**This knot is used when coiling the climbing rope for storage after use (Fig. 6L) and allows the climber to hang the rope up to dry or for storage. If tied successfully, the climber should be able to toss the coiled rope without it uncoiling.

Climbing Procedure

The tree climbing procedure (Fig. 7A–L) began with a pre-climbing inspection to search for any dangers that might impact climbers. The buddy system was used, where each climber had a ground crew member, consisting of one or more individuals instructed in climbing techniques, safety procedures, and collecting protocols. Every member of the climbing team (climbers and ground crew members) wore a hardhat and followed proper safety procedures. Ground crew members were responsible for double-checking the pre-climbing inspection, maintaining the throwline and the climbing rope at the base of the tree, communicating with the climber, and supplying the climber with equipment such as hammers and collecting bags. Eye contact was maintained with the climber to ensure safe conditions, to recover bags of bark collected and dropped to the ground, to collect bark samples at 2 meters in height, to record data on a data sheet, and to manage the perimeter of the tree, thus keeping the area free of debris and hikers away from the hazardous zone.

Each climber wore gloves, safety glasses, and a protective helmet when climbing the tree and taking samples. Safety glasses kept debris out of the climbers' eyes and the helmet protected the climber from falling branches and limbs. The climber wore a long-sleeved shirt, long pants, sturdy hiking shoes, helmet, and a climbing saddle designed for arborists. The long-sleeved shirt and pants prevented abrasion to the skin while maneuvering in the tree, through branches, and also helped prevent insect bites. Ground crew members also wore helmets to protect them from falling branches, limbs, throwbags, collecting bags, and any equipment that needed to be tossed from the canopy by the climber.

When the tree was declared safe for climbing, a 227 to 454 g pellet-weighted throwbag was attached to a lightweight throwline and either thrown (Fig. 7A) or shot over the crotch of the desired tree limb using the "Big Shot" (Fig. 7B). The throwline must be free of knots and neatly coiled into a bag placed approximately one meter in front of the Big Shot. This area must be free of leaves, twigs, and branches to minimize drag when shooting. Preparation to shoot required the throwbag be positioned in the sling and the gripper attached to the sling pulled taut (Fig. 7B). To prevent misfire, the throwbag, throwline and O-ring must be carefully positioned in-line. There was a potential risk of backfiring and hitting the shooter in the face if the Big Shot, throw bag, and throwline were not properly aligned.

One way to ensure success when shooting the throwline and throwbag over the limb was to focus on the target and visualize the throwbag moving over the crotch. Shooting the Big Shot can be done two ways: single-hand method or double-hand method. The single-hand method is best for individuals with strong upper-body strength and allows maximum accuracy by stabilizing the pole with the free hand. The double-hand method can achieve higher shots than the single-hand method but compromises accuracy with both hands being used to pull the sling (Fig. 7B).

Even when the throwbag was successfully shot over the desired crotch of the limb, it does not always reach the ground due to friction caused by rubbing against bark, limbs, vines, and leaves. To correct for this, a variety of techniques were used to lower the throwbag to the ground. The first technique was to whip the throwline up and down in a process called "flipping." This was usually effective when the throwline was stuck in a tree "v" crotch as it lifts the throwline above the crotch, allowing the throwbag to descend. Another method was called the "strumming" technique (Fig. 7C,D). This method was akin to drawing a bow and consisted of pulling the throwline towards the torso with two fingers while keeping the line outstretched

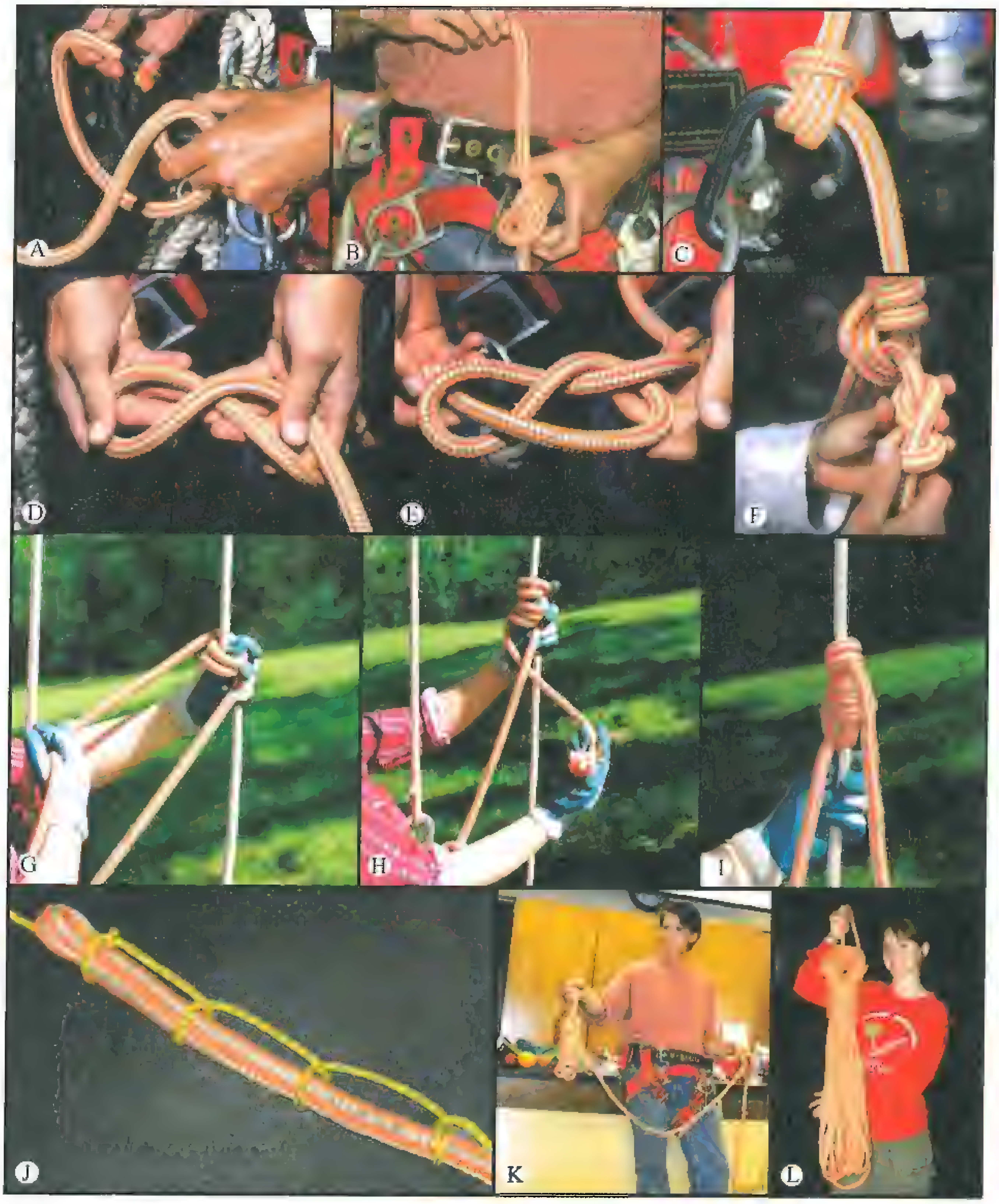

Fig. 6. A–L. Climbing knots. A–C. Anchor Hitch knot. A. Pass the working end of the rope forward over and through the carabineer twice forming two loose turns moving left to right. B. Pass the working end across the two loops from right to left then through the two loops from left to right. C. Tighten and dress the knot and add a figure eight stopper knot. D–F. Figure Eight stopper knot. D. Form the working end of the rope into a loop. Cross the working end over and under the running end forming another loop. E. Pass the working end through the first loop from the front. F. Tighten and dress the knot. G–I. Blake's Hitch Knot. G. Grab working end of rope with left hand. Use left thumb as a spacer and make four to five counter clockwise upward turns with first two or three turns over thumb. Make sure bridge between saddle and Blake's Hitch is not too long or too short. The bridge needs to be a comfortable length in a sitting position, ensure that the extra give from the climbing saddle does not lengthen the bridge to the point that the Blake's Hitch is out of reach. H. Pass the end of the split tail behind turns. Then pass the end of the split tail between bridge and working end of rope. I. Pass the end of the split tail through the lower two or three turns (depending on whether four or five total turns) held by thumb. Dress and set the knot and add a figure eight stopper knot (see F). J. Half Hitch. Pass the end of the throwline around the end of the climbing rope in a clockwise motion. Pass end of throwline over climbing rope and under throwline. Repeat Half Hitch four to five times moving down the climbing rope away from the end of rope. K. Monkey Fist. Coil 3–5 m of working end of rope. Cover the coils with several turns of rope. At end of turns form a loop and pass it through one of the loops formed by the coils. L. Gasket Hitch. Coil all but the last three to five feet of rope. While holding onto coil with one hand, make clockwise horizontal turns around the coil moving towards the head of the coil. Push a bight through and then over the head of the coil and slide bight over coil until it rests on top of the turns. Pull the end of the rope to tighten and set the knot.

with the other hand. By quickly releasing the throwline with the two fingers, a wave of vibrations was sent along the throwline causing it to move toward the ground. When the throwbag reached the ground, the throwline was moved as close to the trunk as possible by using a circular, whip-like arm movement.

Once the throwline was set, it was tied onto the larger climbing rope using a series of half hitches (Fig. 6J) and used to pull the climbing rope over the desired limb. A limb was strongest where it was attached to the tree trunk and therefore it was essential that the climbing rope be positioned as close to the trunk as possible. A whip-like motion was used to move the climbing rope over the limb and next to the trunk. Once the rope was installed, the climber prepared to ascend. Critical supervision by the ground crew was essential as the climber tested the safety of the limb by hanging and bouncing using full body weight with the climbing rope.

Climbing ropes were tied to a climbing saddle using an Anchor Hitch knot or attached using the eye splice to a special D-ring in a process called "tying in" (Jepson 2000) (Fig. 6A–C,G–I; 7E). The working end of the climbing rope was the end attached to the climbing saddle. For right-handed climbers, the working end of the rope was attached to the D-ring on the left side of the harness and became shorter as the climber advanced higher. The running end of the climbing rope was the end that the climber pulled down in order to advance into the tree canopy and became longer as the climber advanced higher. It ran along the right side of the climber's body and was attached to the saddle via a smaller rope, usually around 1.5 m in length, called a "split tail" (Fig. 5A; 6A–C; 7E). The split tail was attached to another D-ring using the eye splice or tied using an Anchor Hitch (on the right side of the saddle for right-handed climbers) and tied to the running end of the rope with a Blake's Hitch knot (Fig. 6G–I).

The Blake's Hitch knot was moved when the climber pulled down on the running end of the rope with the right hand and used the left hand underneath the knot and pushed up, sliding the slack split-tail upward. The climber then used his/her body to facilitate pushing up on the Blake's Hitch knot through a rhythmic thrusting motion of the hips or by bouncing his/her feet off of the tree trunk (Fig.7 G,H). Thrusting and bouncing motions lowered the tension on the climbing rope so that the Blake's Hitch was moved up the slack rope. When the climber was not advancing, the weight of his/her body caused the Blake's Hitch knot to tighten so that it did not slide.

Females on the tree canopy climbing team used a special foot loop technique that allowed them to use their lower body strength to help pull down on the running end of the climbing rope while pushing up on the Blake's Hitch knot (7F,H). The running end of the rope was curved into a loop and held in the climber's right hand. After the climber pushed the foot loop down with either foot and pulled the running end of the rope down with her right hand, she pushed up on the Blake's Hitch with her left hand. This foot loop procedure is described in greater detail in Kilgore (2008); other foot loop techniques are described in Jepson (2000).

A safety rope, also called a lanyard, was used to secure the climber to the trunk or around a branch while he/she was sampling bark or when the working end of the climbing rope is detached from the climbing saddle while the climber was advancing higher in the canopy. To "safety in" at the point of rope installation, the climber installed a short lanyard (more than two meters long), over a branch or around the trunk for an additional safety measure or while maneuvering (Fig. 7K). The lanyard was fastened onto the front attachment point or onto D-rings located on the side of the saddle. The lanyard length was easily adjusted using a mechanical locking system. Lanyards were frequently used in conjunction with the climbing rope to displace pressure points of the climbing saddle, to reduce swinging during ascension, or to pull the climber into reach of grapevines.

Advancement from lower limbs to upper limbs in the canopy required the climber to unhook the working end of the rope from the D-ring, lengthen the working end, and tie a special Monkey Fist knot in the working end (Fig. 6K). Another way was to throw the throwline and throwbag over a limb higher in the canopy much like you would from ground level and then attach the throwline to the working end of the climbing rope using a series of half hitches. Once the climber had thrown the Monkey Fist knot over the

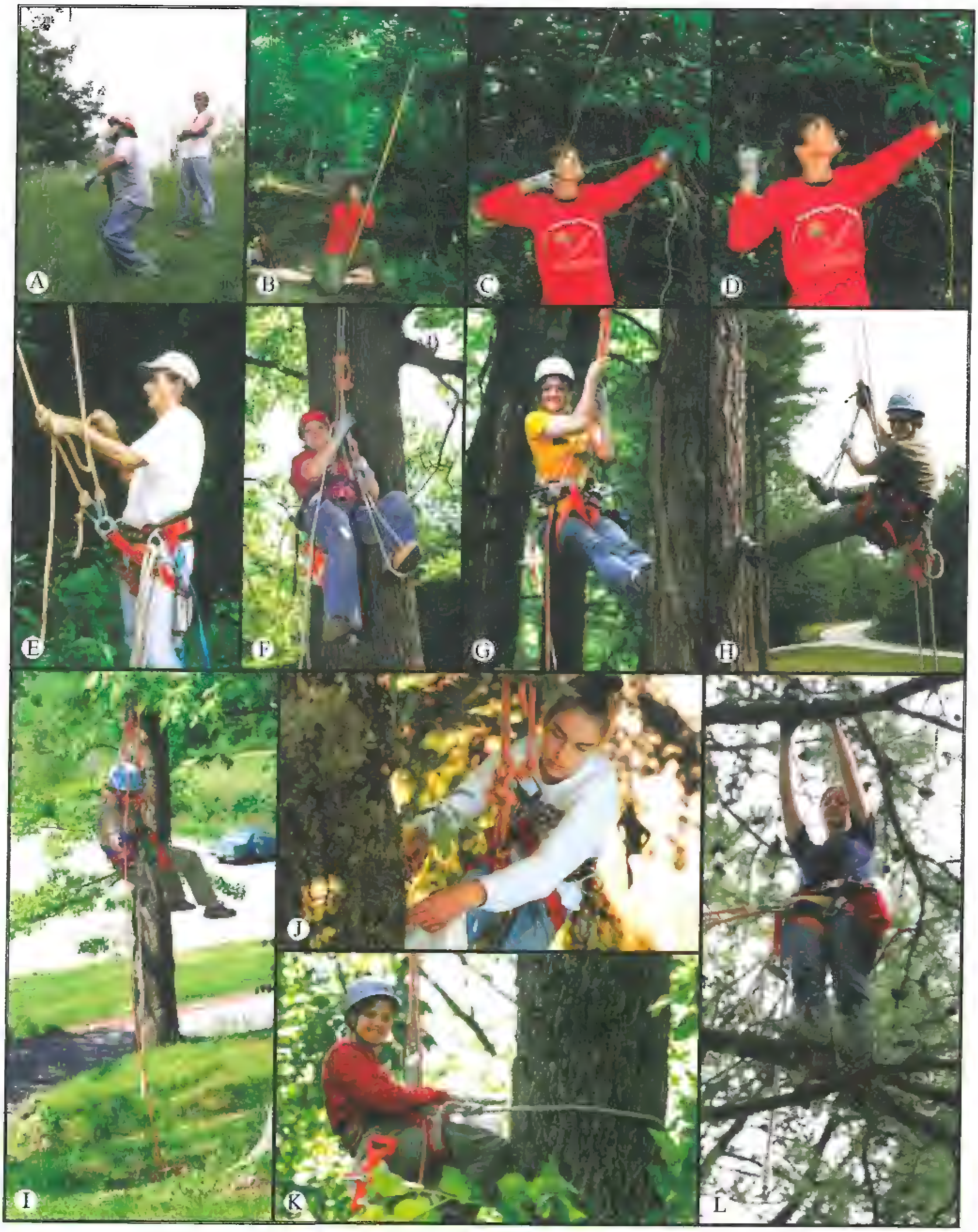

Fig. 7. Tree climbing and collecting procedures. A. Demonstration of hand throwing the throwbag using the throwline and to reach lower heights in the tree canopy. B. Climber using Big Shot in shooting position to release throwbag. C. Climber in position to initiate the strumming technique to create vibrations that lower the throwbag. D. Climber at release point using strumming technique. Note the blue gloves that protect the hands when using throwlines or climbing ropes. E. Climber with climbing rope and split tail tied in to D-rings on bridge of saddle. F. Climber using rope wrapped around left foot creating a foot loop to increase leverage when using the Blake's Hitch. G. Climber walking the tree trunk. H. Climber bouncing off the trunk in a rhythmic thrusting movement and using the foot loop with the right foot. I. Climber in descending position. J. Climber collecting lichen sample and holding the collecting paper bag underneath the knife to catch the bark. Note that both hands are free using the DRCM. K. Climber shown in collecting position with orange climbing rope installed higher in the tree and the white lanyard tied in around the trunk of the tree. This is the proper work position to collect bark samples with knife in one hand and paper bag in the other. L. Climber limb walking on thick branches of *Pinus echinata* to collect female cones. Not shown was the climbing rope around the tree trunk and limb above the climber.

desired limb higher up in the canopy, or attached the climbing rope to the throwline and hauled it over the limb, the working end of climbing rope was reattached to the saddle.

The DRCM allowed climbers the freedom to use both hands to reach and sample tree bark in a vertical transect from near ground level to near the apex of a tree (Fig. 7J,K) It was important to remember how high the rope was secured in the tree, especially after advancing into the upper canopy. If the climber was higher than half the length of the rope, the climber ran out of rope during descent. When this happened, the climber stopped at one of the lower limbs, re-attached the rope to a lower limb and descended again. Descending from the canopy required the climber to slowly pull down on the Blake's hitch knot while holding onto the running end of the climbing rope to control speed (Fig. 7I). It was important to control speed while descending so that the rope and gloves were not burned due to friction in too rapid a descent.

Bark collection at 3 m increments up to 35 m took three hours or longer, depending on the difficulty of removing bark, maneuvering around limbs, difficulty reaching grapevines, and advancing higher to reach leaf voucher specimens from the outer canopy. Although the saddle was padded, extended periods of time hanging in the saddle caused pressure points to develop and legs to go numb. Numb legs were revitalized by inverting the body or walking up the trunk and leaning back so the body was positioned with the legs above the head. The climber could also stand on a limb or lie back on a limb to reduce pressure on the legs.

The DRCM was most efficient for sampling organisms from the trunk of the tree or from the parts of the limbs closest to the trunk. However, samples may need to be collected from the outer limb and requires the climbers to use a method called "limb walking" (Fig. 7L). This required the climber to advance to the apex of the canopy and secure the rope around the trunk of the tree and at least one limb for stability. The climber then determined the straightest path through the canopy to the target limb below. Once the climber descended to the target limb, the rope was tightened so the climber could stand on the limb. Facing the trunk of the tree, the climber proceeded to walk backwards while holding onto the rope and gradually slid the Blake's Hitch down the rope to keep tension on the rope. When the climber reached the desired distance from the trunk the targeted aerial structures near the outer canopy were sampled. To return to the trunk, the climber stood on the limb and slid the Blake's Hitch up the rope maintaining rope tension.

Student field research experiences and activities

This project required team effort (Fig. 8A–J). The "ground crew" included multidisciplinary experts who served as mentors for the students. These experts gave special lectures, slide shows, and field demonstrations during evenings or on rainy days on the targeted groups of organisms to aid the student climbers in the recognition and collection of specimens and suitable bark samples. Each evening, students sorted bark samples, separating mosses, liverworts, and lichens and prepared voucher herbarium specimens for the tree species (Fig. 8A). Other evening group activities that helped break the work routine and keep morale high were playing cards, baseball, Frisbee, yard darts, and inviting park personnel and friends for a group supper cooked by the students.

Field research was divided into 2 three-week sessions during the period from June to August. Students climbed for six consecutive days with one day of free time. Some students collected myxomycete specimens at night with a flashlight with a focused spotlight that enabled students to collect myxomycetes on the underside of decaying logs. Tiny myxomycete sporangia in various stages of development glisten and become more conspicuous at night when a directed light beam highlights areas of the log difficult to observe in daylight hours. This was especially true for extensive fruitings of different species of *Cribraria* and *Echinostelium minutum* de Bary on decaying conifer logs (Keller 2004a). These night-time forays with flashlights led to the first observations of slugs feeding on the immature fruiting body stages of myxomycetes (Keller & Snell 2002b). Trail excursions sometimes led to unusual observations such as a millipede feeding on an immature stage of a myxomycete fruiting body (Fig. 8B).

One of the most remarkable discoveries was a new species of myxomycete, *Diachea arboricola* H.W. Keller & M. Skrabal. Melissa Skrabal observed the myxomycete plasmodial tracks and beautiful iridescent sporangia from 9–24 meters on the bark surface and fissures of a white oak tree (Keller & Skrabal 2002;

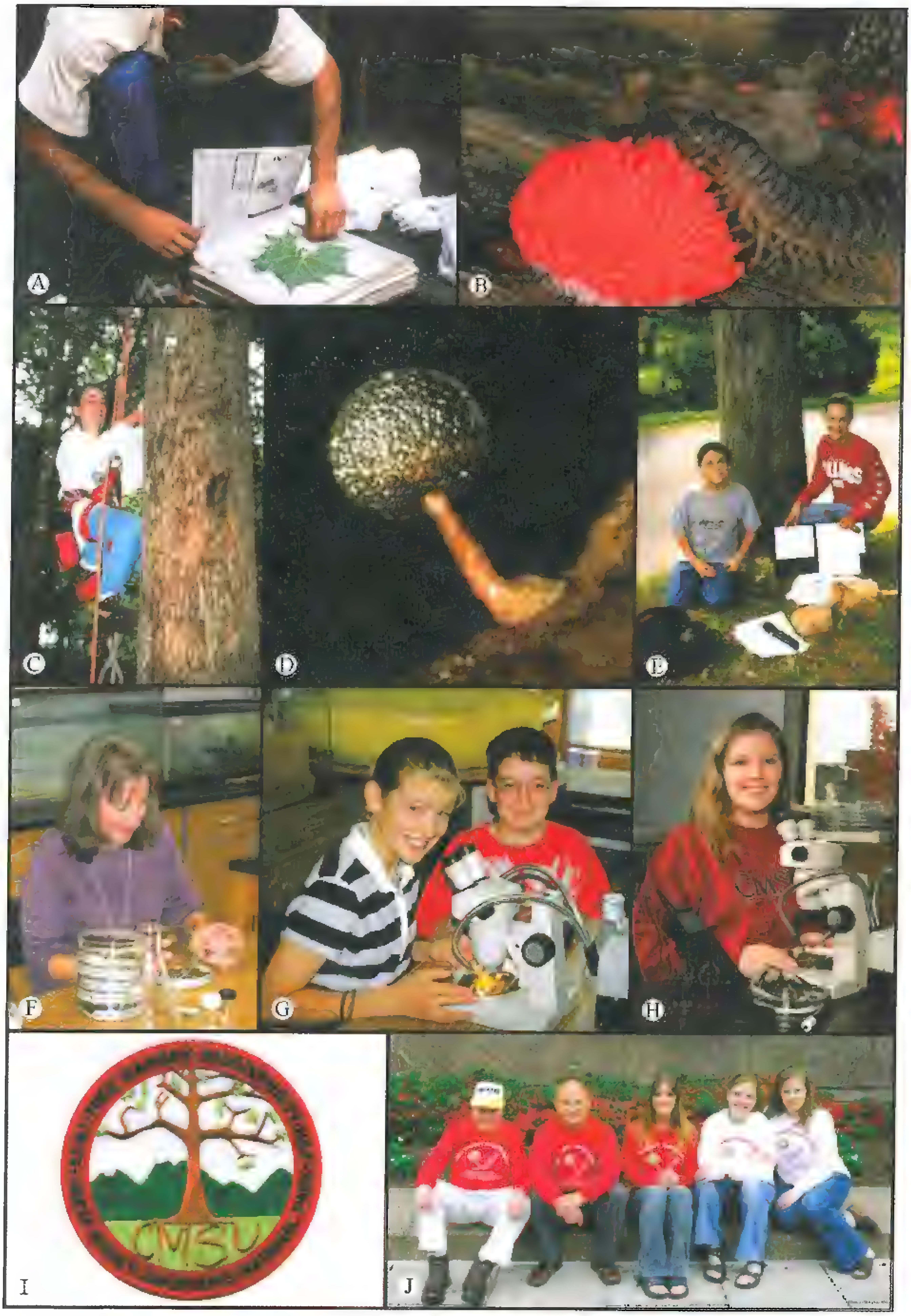

Fig. 8. A–E. Adventure Phase. A. Preparation of tree voucher specimens using plant press. B. Trail excursions resulted in the first observation of a female millipede of *Abacion magnum* (Loomis) feeding on an immature, bright red, myxomycete fruiting body of *Tubifera ferruginosa* (Batsch) J.F. Gmel. C. Climber ascending *Quercus alba* tree collecting sporangia of a new tree canopy species, *Diachea arboricola*. D. Stalked sporangium from C with iridescent peridium showing glittering silver, gold, and and bluish colors. F–H. Laboratory Phase. F. Trish Smith preparing moist chamber bark cultures for classroom study. G. Two seventh grade students scanning moist chamber bark cultures with stereomicroscope. H. Image of Angela Scarborough on front cover of the UCM McNair Journal. Note moist chamber culture with wet bark, pH meter, and stereomicroscope. I. Tree canopy biodiversity logo made into a cloth patch, color sketch by Melissa Skrabal. J. Group picture of UCM tree climbing team at the National Geographic Society Headquarters, Washington D.C.

Keller et al. 2002; Keller et al. 2004) (Fig. 8 C,D). This was an example of a woman in science doing fieldwork that required strength, agility, and athleticism. She represents a role model for other young women to follow in her footsteps. She also designed and sketched our tree canopy biodiversity logo which was made into a cloth patch to provide research team members, volunteers, park personnel and interns, reporters, and friends with a memento of our tree canopy biodiversity research project. The logo recognizes the support of NSF and BS&I and our home institution Central Missouri State University (now UCM). More than 100 of these patches were distributed and are posted on bulletin boards, worn on blazers or jackets, or to help identify gear bags or backpacks (Fig. 8I). A book entitled *Fungi* introduces a new series of Ranger Rick Books for children in grades 3–5. Including a section entitled *Exploring for Fungi* that features Melissa Skrabal collecting lichens and *Diachea arboricola* high in the tree tops in GSMNP (Carson 2003).

The NSF-Research Experience for Teachers Program facilitates professional development of K–12 teachers on the cutting edge of science through partnerships between local school districts and universities (Keller et al. 2005). Trish Smith, a Warrensburg Middle School seventh grade life science teacher, along with students and faculty from UCM, participated in a summer tree canopy biodiversity project in the GSMNP (Fig. 8F). The project created a website at http://warrensburg.k12.mo.us/iadventure/GSMNPiadventure/ where the field Adventure Phase "Exploring Life in the Forest Canopy," represented the first tier of the iAdventure website. This innovative website enabled students and teachers to experience tree canopy research and learn about the All Taxa Biodiversity Inventory as part of the Adventure Phase (Fig. 8E). This was followed by the Laboratory Phase where students observed moist chamber cultures with wet bark that enabled students to observe a living miniature ecosystem composed of myxomycetes, fungi, lichens, mosses, liverworts, green algae, cyanobacterial algae, myxobacteria, tardigrades, insects, nematodes, and possibly other invertebrates (Fig. 8G). The students found several rare myxomycete species such as *Echinostelium arboreum* H.W. Keller & T.E. Brooks, known only from a few locations in the world.

The second tier of the website at http://warrensburg.k12.mo.us/iadventure/whatis.html was an iAdventure problem solving activity. Students determined the direction and outcome of a content-rich storyline, using resources available on the Internet, including resources that provided real-world data and primary literature sources. This activity was designed to help students discover how to use and access data and information on the Internet, and to solve problems and make choices. Students were expected to develop their own research questions, design their own experiment or investigation using the specimens and collected data. This subsequently led them to the Publication Phase, where they were expected to create poster presentations shared with parents and the school community. These classroom activities and website experiences encouraged secondary students to choose field biology as their future career (Smith & Keller 2004).

Student Research Special Recognition

Kenneth (Kenny) L. Snell was a graduate of the first tree climbing school and served as an instructor in later years (Fig. 6K, 7E). His leadership and mentorship in the field was a valuable resource for future student climbers. He was the project leader beginning the summer of 2000 and created the tree and myxomycete database for future research projects. His master's thesis (Snell 2002) resulted in the first tree canopy paper published on Myxomycetes (Snell & Keller 2003). Discover Life in America highlighted his accomplishments at UCM in the lead article published in the All Taxa Biodiveristy Inventory Quarterly (Keller 2002b). Kenny received two UCM awards, the Reid Hemphill Outstanding Scholar for his scholarship, research, and citizenship; and the university-wide Graduate Thesis Award for the best graduate thesis for the year 2002.

Erica E. Parker was a McNair Scholar Award Recipient at UCM. This program prepares first-generation, low-income, undergraduate college students for doctoral study. Approximately 24 students were selected as eligible McCAP participants. She was awarded first place for the best research paper (Parker & Keller 2003).

Angela R. Scarborough was selected as a McNair Scholar that resulted in her being featured on the front cover of the McNair Journal (Scarborough 2005) (Fig. 8H); and her research paper presented at the

Association of Southeastern Biologists (ASB) 2006 Annual Meeting won the Outstanding Microbiology Award (Scarborough 2006a) and her poster won the Elsie Quarterman-Catherine Keever Award for the best ecological poster (Scarborough 2006b).

Sydney E. Everhart, a UCM graduate student, won the Outstanding Microbiology Award for the best paper presentation at the ASB 2007 Annual Meeting (Everhart et al. 2007a), and also the Elsie Quarterman-Catherine Keever Award for the best ecological poster (Everhart et al. 2007b). Her master's thesis (Everhart 2007) submitted to UCM was recognized by the University Research Council as the best graduate student thesis in 2008.

Courtney M. Kilgore received the Nahm Award for the Outstanding Graduate Student from the UCM College of Science and Technology. The selection criteria included a major in a graduate program within the College and demonstrated performance in leadership, scholarship, and citizenship. She also was the winner of the Mycological Society of America official conference t-shirt design for the annual 2008 meeting held at Pennsylvania State University. Four edible, mushroom cultivars were included in the winning design, Shiitake (*Lentinula edodes*), Hen of the Woods (*Grifola frondosa*), button mushroom and Portabella white and brown variety (*Agaricus bisporus*), and the velvet foot mushroom (*Flammulina velutipes*), and five molds around the circular border: *Alternaria, Aspergillus, Fusarium, Penicillium,* and *Trichoderma*. The design style was reminiscent of early taxonomical drawings and scientific illustration with a classic art nouveau border to frame the design.

Special Media Highlights

One of the objectives of this tree canopy project was to involve volunteers, park interns, undergraduate and graduate students, in interpretive exhibits, news media coverage (print and television), publication of technical articles in peer reviewed journals and also in popular magazines that sent a powerful conservation message for biodiversity. The grants acknowledged here for the period 2000 to 2008 resulted in 20 refereed papers in scientific journals, 15 articles published in newsletters, mostly in the Mycological Society of America newsletter *"Inoculum,"* the *"ATBI Quarterly"* from Discover Life in America, and *"What's Up"* from the International Canopy Network. The majority of these articles were on the front cover as the lead article. Abstracts (74) were represented by power point and poster presentations given at many different professional meetings. Four master's degree theses were completed during this period.

The media coverage gave the public a better understanding of the occurrence and importance of mostly cryptogams such as myxomycetes, macrofungi, mosses, liverworts, lichens, and ferns and observations on invertebrates, including insects, mollusks, and tardigrades. Media attention highlighted the DRCM and reporters interviewed students and project team members. Interpretive exhibits, newspaper articles, popular books for children, and television feature stories based on our tree canopy exploration and discoveries in the GSMNP were described by Keller (2004a).

Rock Creek National Park, located in Washington D.C., hosted the first 24-hour BioBlitz held May 18–19, 2007, jointly sponsored by the National Geographic Society (NGS) and the National Park Service (NPS); Fig. 8J). Student climbers demonstrated the use of the DRCM when sampling bark for myxomycetes. The BioBlitz which began in 2007, will be held annually in urban areas of NPS units for the next 10 years with the goal of increasing public awareness through the documentation of species inventory, public outreach activities, and science education for all age groups (Kilgore 2007; Kilgore & Keller 2007). This first BioBlitz drew media coverage that resulted in a photo of Sydney E. Everhart on the front page of the Metro section of the May 19th, 2007 issue of the Washington Post. Perched in her climbing saddle in the top of a white oak tree canopy, she collected bark samples that were later transported to the laboratory and cultured in moist chambers for myxomycetes and other organisms. Video of this event is available for viewing at this URL address: http://video.nationalgeographic.com/video/player/specials/films-specials/. The NGS video page will load and the featured video will begin to play. In the dialogue box that says "search all videos" enter "Rock Creek Bioblitz" and press "GO."

More recently, National Geographic Television produced two films "BioBlitz Rock Creek Park 2007" and "Smoky Mountains Treetop Exploration," that appeared as part of the *Wild Chronicles* series on Public Broadcasting Stations (PBS) nationwide. The former as Episode #236, August, 2007 and the latter as Episode #318, February, 2008, and had a running time of seven minutes for each episode. Boyd Matson was the host and narrator. National Geographic Society Mission Programs supports pioneering research and field expeditions through programs such as the Committee for Research and Exploration.

During July of 2007, National Geographic Television Producer Jason Orfanon shot 10 hours of film footage over a five-day period in the GSMNP. The storyline documented the exploration of the tree canopy using the DRCM by a research team of two University of Central Missouri graduate student climbers, SEE and CMK, who demonstrated how to access, climb, and gather bark samples with myxomycetes, macrofungi, lichens, mosses, and liverworts from the tree canopy. Harold W. Keller coordinated the ground crew and served as the principal investigator for the research project entitled "RUI: Biodiversity and Ecology of Tree Canopy Biota in the Great Smoky Mountains National Park." Video is available for viewing at this URL address: http://video.nationalgeographic.com/video/player/specials/films-specials/. The NGS video page will load and the featured video will begin to play. In the dialogue box that says "search all videos" enter "Smoky Mountain Tree Canopy" and press "GO." Films will appear as blocks. Click the second block that is called "In Search of Slime" which has a beautiful color image of a sessile, densely netted, plasmodiocarpous fruiting body with a conspicuous bluish iridescence of the rare myxomycete *Didymium perforatum* Yamash.

In addition to the video, Matson also conducted a 20-minute interview with CMK and HWK about their tree canopy adventures, which aired on *National Geographic Weekend*. This is a new radio program hosted by Boyd Matson that highlights stories of "exploration to the far corners of the planet and the hidden corners of your own backyard." It airs on radio stations on Saturdays and Sundays.

RESULTS

Tree and Vine Species Climbed and Sampled

Tree and vine species represented 52 taxa and more than 500 individual trees were climbed over the eight year period of this project. Some species of trees are represented by many individual trees, for example, *Acer rubrum, A. saccharum, Fraxinus americana, Juniperus virginiana, Liquidambar styraciflua, Liriodendron tulipifera, Picea rubens, Pinus echinata, P. strobus, Platanus occidentalis, Tsuga canadensis,* and grapevines, *Vitis aestivalis,* and *V. vulpina*. Some of the tree species were scattered, fewer in number, and difficult to find, but the species given here occurred in greater numbers, were closer together, easier to locate and climb, and larger. These trees met our climbing criteria for bark sampling. Trees were located using trail guides, vegetation maps, consultation with local residents, park and state officials, and questioning hikers on the trail (Keller 2006).

Tree and vine species listed alphabetically: *Abies fraseri* (Pursh) Poir., *Acer negundo* L., *A. rubrum* L., *A. saccharinum* L., *A. saccharum* Marsh., *Aesculus flava* Aiton, *A. octandra* Marsh, *Ampelopsis cordata* Michx., *Betula alleghaniensis* Britton. *B. lenta* L., *Carya alba* (L.) Nutt., *C. cordiformis* (Wangenh.) K. Koch., *C. glabra* (Mill.) Sweet, *C. illinoinensis* (Wangenh.) K. Koch., *Cercis canadensis* L., *Cornus florida* L., *Diospyros virginiana* L., *Fagus grandifolia* Ehrh., *Fraxinus americana* L., *F. pennsylvanica* Marsh., *F. profunda* (Bush) Bush, *Halesia carolina* L., *Juglans nigra* L., *Juniperus virginiana* L., *Liquidambar styraciflua* L., *Liriodendron tulipifera* L., *Magnolia acuminata* (L.) L., *Nyssa sylvatica* Marsh., *Picea rubens* Sarg., *Pinus echinata* Mill., *P. strobus* L., *Platanus occidentalis* L., *Populus deltoides* Bartram ex Marsh., *Prunus serotina* Ehrh., *Quercus alba* L., *Q. falcata* Michx., *Q. michauxii* Nutt., *Q. montana* Wild., *Q. muehlenbergii* Engelm., *Q. prinus* L., *Q. rubra* L., *Q. velutina* Lam., *Robinia pseudoacacia* L., *Sorbus americana* Marsh., *Taxodium distichum* (L.) Rich, *Tilia americana* L., *T. heterophylla* Vent., *Tsuga canadensis* (L.) Carr., *Ulmus americana* L., *U. rubra* Muhl., *Vitis aestivalis* Michx., and *V. vulpina* L.

Myxomycete Species on Trees and Vines

Corticolous myxomycetes complete their entire life cycle only on the bark of living trees and vines (Keller

& Braun 1999; Everhart & Keller 2008). Some corticolous myxomycete species were collected in the field directly on the bark of living trees and vines and some were harvested from laboratory moist chamber cultures. Bark characteristics and pH were important factors in the occurrence and distribution of myxomycetes on living, healthy trees and vines (Snell & Keller 2003; Keller 2004a; Parker & Keller 2004; Scarborough 2006a; Keller & Everhart 2008; Everhart et al. 2008). The more productive trees for corticolous myxomycete species are included here with the total number of species found to date. These numbers were compiled from previous publications (Martin & Alexopoulos 1969; Keller & Braun 1999; Parker & Keller 2003; Parker & Keller 2005; Scarborough 2005; Scarborough 2006b; Snell & Keller 2003; Snell et al. 2003; Everhart & Keller 2008; Everhart et al. 2008; Kilgore 2008). The number of different myxomycete species on trees and vines are listed from highest to lowest, with number of species in parentheses: *Juniperus virginiana* (54), *Acer rubrum* (49), *Quercus alba* (43), *Liriodendron tulipifera* (41), *Vitis aestivalis* (39), *Fraxinus americana* (31), *Vitis vulpina* (25), *Pinus strobus* (24), *Ulmus americana* (20), *Acer saccharum* (17), *Tsuga canadensis* (17), and *Pinus echinata* (14). All other trees had fewer species than listed here and *Abies fraseri* had no myxomycete species above diameter at breast height.

The mean pH is given for the above listed tree species from the highest pH to the lowest. *Juniperus virginiana* had the highest pH (7.3) bark values, highest water absorption capacity, and the highest corticolous myxomycete species diversity based on our field and laboratory tree canopy studies to date (Keller & Braun 1999; Keller 2004a). *Ulmus americana* (7.0) and *Fraxinus americana* (6.7) also had thick bark with high water absorption capacity (Parker & Keller 2003). *Quercus alba* (5.7), *Vitis vulpina* (5.5), *Acer saccharum* (5.5), *Liriodendron tulipifera* (4.9), *Vitis aestivalis* (4.8), *Acer rubrum* (4.7), *Tsuga canadensis* (4.1), *Pinus strobus* (3.8), and *Pinus echinata* (3.8) represent the rest of the tree and vine species (Snell & Keller 2003; Everhart et al. 2008; Kilgore 2008). The last three tree species had the lowest pH and lower number of myxomycete species in part due to the lower pH and lower water absorbing capacity. This trend of a lower pH range associated with especially resiniferous gymnosperm tree bark, resulted in the lowest number of myxomycete species.

FUTURE DIRECTIONS

The results and scope of this project demonstrate that the DRCM is an alternative way to study tree canopy biota. Nevertheless, additional research is needed to answer questions about organisms in hard to reach places. For example, limb walking using the DRCM facilitates sampling from the trunk axis to the outer periphery of the tree. Studies using DRCM and limb walking are capable of sampling aerial reproductive structures, such as gymnosperm female cones (*Pinus* spp.), pods from *Cercis canadensis*, ball-like fruiting structures of *Liquidambar styraciflua* and the long pods of *Catalpa speciosa* (Warder) Warder ex Engelm. (Kilgore 2008).

Further research in the tree canopy is needed to document the vertical distribution of lichen growth forms (crustose, foliose, and fructicose) and lichen species among these three growth habits from the tree base at ground level to the treetop (Ciegler et al. 2003; Lumbsch et al. 2005; Fanning et al. 2007; Keller et al. 2007).

Little is known about the distribution of mosses and liverworts (bryophytes) from vertical transects along tree trunks. Most of the species found to date in the tree canopy also occur on ground sites. This is another group that should be targeted for more tree canopy survey and inventory (Davison & Keller 2004).

The presence of basidiomycetes and ascomycetes on the bark surface and in tree crotches should be targeted for collection and identification. No ascomycetes were collected and identified in our bark cultures, but they were present nevertheless. Only five basidiomycetes were collected on healthy living trees-certainly a scanty harvest.

The total height and diameter of the tree should be supplemented with core samples to determine the actual age by counting tree rings. The actual age of the tree is lacking in most studies and this piece of data would match size and age of trees and the time needed for organisms to colonize the bark surface. This invasive technique would require special permission from the National Park Service or the United States Forest Service, or be conducted on private property.

Bark samples were prepared in moist chamber cultures immediately or within several months after field collection. Laboratory protocols should include exactly how old the bark samples were when first wetted in moist chamber cultures. Storage at room temperature in sample bags enclosed inside of a large paper bag and tightly sealed for 12 to 24 months or longer increases the chances of filamentous mold contaminants, especially species of *Trichoderma*, mucoraceous species, *Aspergillus* species, and unidentified white molds.

Myxobacteria appear quite frequently in moist chamber cultures of bark from living trees and vines and represent a group of understudied organisms with potentially unidentified species which are strictly arboreal. Bark and grapevine samples from the tree canopy also have nematodes and tardigrades, and these organisms mostly are known from ground level sites. The role of nematode interactions with myxomycete plasmodia needs further study based on recent results (Kilgore & Keller 2008).

Observation and collection of snails and slugs along the tree trunk was possible using the DRCM. Slugs, *Philomycus carolinianus* (Bosc) and *P. flexuolaris* Rafinesque, were documented at heights up to 14 m on the trunk and around a treehole filled with water (Keller & Snell, 2002b). Snails with shells, for example, *Mesodon normalis* (Pilsbry) about the size of a quarter, and *Anguispira jessica* Kutchka about the size of a dime, appeared to move from ground level up to 15 m in the former and 24 m in the latter. The DRCM is the best way to record slug and snail movements in the tree canopy and determine if any species are arboreal. Little is known about tree canopy slugs and snails (Thomas Watters and Dan Dourson, pers. comm.).

Epiphytic plants in the tree canopy should also be studied. *Pleopeltis polypodioides* (L.) Andrews & Windham (the resurrection fern), was found in large conspicuous clumps along the trunk and branches at lower heights on a national champion tree, *Fraxinus profunda* (Bush) Bush in Big Oak Tree State Park, Missouri (Keller pers. obs.). This fern was observed easily with the unaided eye, and other epiphytes may be seen with ground-based binoculars higher in the canopy. In some cases the location of epiphytes eludes even the sharpest eyes and binoculars, and only the DRCM made it possible to see these plants higher in the tree canopy. The typically lithophilic *Polypodium appalachianum* Haufler & Windham (Rock Cap Fern) was discovered as a tree canopy epiphyte 35–40 m above ground on a horizontal branch in a champion-sized *Liriodendron tulipfera* in the GSMNP. Even though this fern had leaves up to 16 cm long and 5 cm wide, it could not be seen with ground-based binoculars because of the height and location on the upper side of a horizontal branch (Keller et al. 2003). Tiny epiphytic plants that include orchids and other vascular plants may represent arboreal species that can be detected only by using the DRCM. Vertical transects of the bark surface can be scanned from the base to the top of the tree canopy visually or using a 20× hand lens for tiny organisms.

Certain corticolous myxomycetes only are known from the tree canopy such as *Trabrooksia applanata* H.W. Keller. This myxomycete species and many others should be cultured from spore to spore and DNA analysis determined to correctly classify and develop phylogenetic relationships instead of morphospecies concepts (Keller 1996; Keller 2005c; Keller & Everhart 2008).

Many more studies using rope climbing methods are needed to determine if arboreal biota exist in the tree canopy of temperate forests. Research projects using the DRCM will help the next generation of tree canopy biologists to explore, ask questions, and develop hypotheses that will increase our knowledge of the biosphere.

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Trish Smith involved seventh grade life science students at Warrensburg Middle School with the Research Experience for Teachers project by culturing myxomycetes in the classroom, developed an interactive website for students to participate in their own tree canopy adventure, and invited members of the UCM tree canopy team to visit the classroom to help identify organisms in moist chamber cultures. Jean Gerrath and Jay Raveill assisted students in identifying grapevine and trees vouchers respectively. Gabriel Moreno produced valuable scanning electron micrographs of myxomycete species that had unusual characteristics. Uno Eliasson aided in collecting and identifying myxomycete specimens that were new records or had unusual characteristics, and he reviewed papers for publication. Karl and Jeanne Braun and Ted Stampfer reviewed numerous papers for publication.

Robert Breshears, Mike Ferro, Jim Murray, and Glenda Carmack volunteered their photographic skills and accompanied team members into the field on numerous occasions to visually record the DRCM. Many of their photographs appear in publications produced by the tree canopy team. Photo credits: James Murray = Figs. 1A,B,F,G, 3H, 5A, 7E,J, 8A,C; Courtney M. Kilgore = Figs. 1C,K, 4C; Harold W. Keller = Figs. 1D–E,H–J, 3G, 4D–E, 5B,D, 6J,L, 7F–I,L, 8F–G,I; Glenda Carmack = Figs. 2A, 3B,D,F; 4A, 5C, 6A–F,K, 7A, 8E; Jerry Coule = Fig. 2B–C; Mike Ferro = Fig. 3A,C,E; Kenny L. Snell = Fig. 4B; Robert Breshears = Figs. 6G–I, 7B–D,K, 8J; Stan Smith = Fig. 8B; Sydney E. Everhart = Fig. 8D; Bryan Tebbenkamp = Fig. 8H.

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ARISTOLOCHIA SCHULTZEANA (ARISTOLOCHIACEAE) NEW TO ECUADOR

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ABSTRACT

Aristolochia schultzeana is a rare, low-elevation, humid, pluvial forest species. It was previously known only from Colombia but is now reported for Ecuador.

RESUMEN

Aristolochia schultzeana es una especie rara de los bosques húmedos y pluviales de baja elevación. Previamente, esta especie se conocía solamente de Colombia, pero ahora se reporta para Ecuador.

In July 2007, while I was teaching a neotropical plant diversity class for Arizona State University's Andes and Amazon Field School, in the western part of the Amazonian region of Ecuador, a student produced a strange, spectacular and relatively large *Aristolochia* flower from a forested area at the edge of a nearby village. The flower was reminiscent of a *Nepenthes* or *Sarracenia* leaf, with an elongated floral tube terminated with two limb lobes, a small lower (anterior) lobe and a large, erect and expanded upper (posterior) lobe that was yellow with red-brown veins to the inside and with a margin of fleshy, forked, black fimbriae (Fig. 1). Unpleasantly scented, reminiscent of dead fish, I received the flower slightly dehydrated with the upper limb lobe hanging over the mouth of the floral tube. After taking several high-resolution digital photographs (300 dpi), the flower was placed in a plastic bag with some water, successfully rehydrating it and returning the posterior limb lobe to a vertically-erect position. Thereafter, several more photos were taken, including dissections and close-ups of the flower. Several days later I was taken to the actual plant in the field, which was a large vine with cordate leaves, growing just inside the edge of a young forest. It was not flowering or fruiting at the time. I was unable to obtain necessary collection and plant-export permits prior to my visit to Ecuador, therefore no herbarium specimen was made of this plant. It was not until several months later, using the photographs, that I identified this species as *Aristolochia schultzeana*, later confirmed by Favio González at the Herbario Nacional Colombiano. Furthermore, while researching this identification I learned this was apparently the first report of this species for Ecuador and only the third report for this species overall, suggesting that this is a species of striking global rarity. While photographing this plant I was unaware that I was documenting something of any significance, as my photos at the time were for the benefit of my curiosity alone.

Voucher: **ECUADOR. Provincia del Napo:** on a moderate, north-facing slope, along a trail just inside and near the edge of a second-growth rainforest, in a spot apparently used to put cut wood; ca. 10–20 m S of the well-traveled, paved road near the S side of the Río Napo in the Quichua (Kichwa) village of Santa Urcu, within 100 m of the Casa Comunal and ca. 15 km via air ESE of Tena; elev. ca. 440m; ca. 01°03'01.9"S, 77°41'06.5"W; UTM 18M 201152E, 9883757N (WGS84), 18 Jul 2007, *D. Goldman 3990* (BH, COL, GH, QCA).

The voucher consists of a printed set of 28 digital color photographs of the one flower found of this species, all but one photograph taken by myself, each printed on paper 25 cm × 18 cm, with scale indicated, all bound as a unit and mounted or contained on a single herbarium sheet. In addition, this photo-set has been deposited in the botany libraries at Harvard University (both printed and on a compact disk), and is also available for viewing in Morphbank, an archival, web based, public-access database of images of biological specimens for scientific study (www.morphbank.net).

Aristolochia schultzeana O.C. Schmidt is a humid-tropical rainforest species that previously had been considered endemic to southern Colombia, where apparently it has been collected only twice (González

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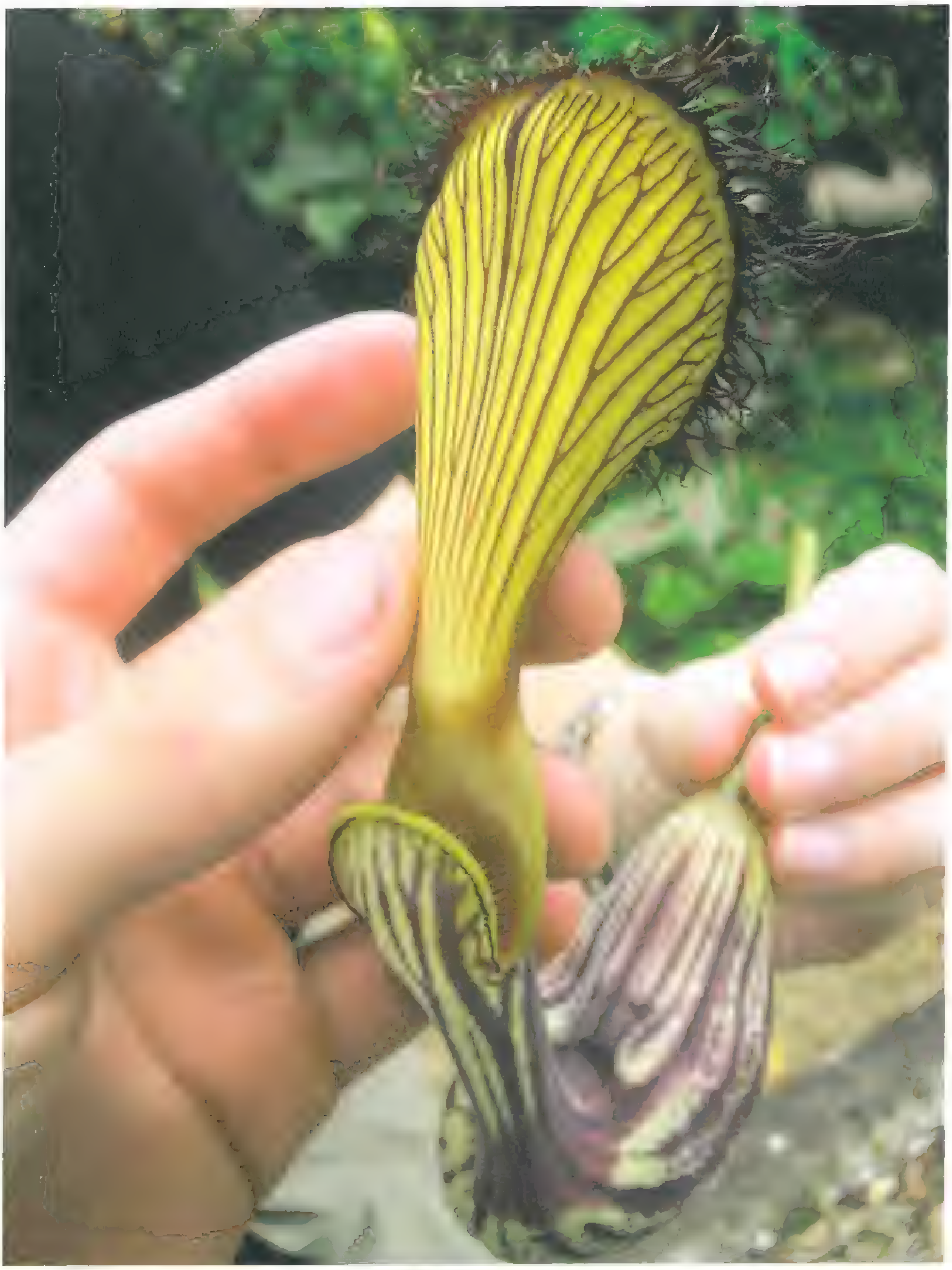

Fig. 1. Fresh flower, July 18, 2007. Photo credit: Kenny Richards.

1990). Hohene (1942) mentioned this species was present in Bolivia, but he did not cite any Bolivian specimens. The type locality is to the east side of the Andes in Colombia, near Umbría in the Departamento del Putumayo, 0°54'N, 76°10'W, 325m altitude, Oct–Nov 1930, *G. Klug 1786* (B [holotype, destroyed], BM, F, GH, K, MICH, NY [lectotype, designated by González 1990: 125], S, US). The second collection from Colombia is relatively close to the Pacific coast, near Llorente, Tumaco, Departamento del Nariño, 8 Sep 1976, *O. de Benavides 628* (COL). See González (1990) for a summary of this species in Colombia. Because this species is known, although sparingly, from within about 50 km of the Ecuadorean border, its discovery in Ecuador has been anticipated for some time (González 1994, 1999). Although it could have been expected that this species would first be found in Ecuador very close to the Colombian border, this newest record represents a range extension or perhaps a disjunction, found a minimum of about 160 km from of the Colombian border and approximately 270 km from nearest Colombian site for this species (in Putumayo). This suggests that the species could be more widespread than expected in the region, and its occurrence adjacent to a well-traveled, paved road suggests that it is more common than previously considered but simply overlooked, or that it flowers infrequently.

Aristolochia schultzeana is similar to another, but more widespread, tropical rainforest species, *A. didyma* S. Moore, found in scattered localities throughout northern South America (Foster 1958; González 1994; Hoehne 1942; Macbride 1937). Both species have large, cordate leaves, lack pseudostipules, have flowers of similar overall shape, fimbriate upper limb-lobe ornamentation, and floral coloration and patterning. However, *A. didyma* has a syrinx (an internal, downward projection of the floral tube into the utricle) which *A. schultzeana* lacks. Furthermore, the upper (posterior) limb lobe of *A. didyma* is deeply bifid apically with a tiny mucro in the sinus, whereas *A. schultzeana* has an undivided upper limb lobe with an elongate (7–15 mm) apical mucro. See Hoehne (1942) and González (1994) for a full comparison and illustrations of these two species.

Some local residents near the field site in Ecuador commented to me that this plant can be propagated from cuttings. This suggests that people in Santa Urcu and other nearby Quichua communities may have specific uses for this plant, although an exact use was not mentioned. *Aristolochia* spp. are commonly used in Ecuador for digestive-related ailments or occasionally malaria (Ríos et al. 2007), particularly in the Amazonian region.

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BOOK REVIEW

STEPHEN S. WHITE AND MARSHA V. GALLAGHER (EDS.), with translation by WILLIAM J. ORR, PAUL SCHACH, AND DIETER KARCH. 2008. **The North American Journals of Prince Maximilian of Wied: May 1832–April 1833.** (ISBN-10: 0806138882; ISBN-13: 978-0806138886, hbk.). University of Oklahoma Press, 2800 Venture Drive, Norman, Oklahoma 73069-8218, U.S.A. (**Orders:** www.oupress.com, 800-627-7377). $85.00, 544 pp., color and black and white illustrations, 12" × 8".

Made famous through the paintings of Swiss artist Karl Bodmer, the North American expedition of German naturalist Prince Maximilian of Wied in 1832–34 was the first scientific exploration of the Missouri River's upper reaches since the epic journey of Lewis and Clark almost thirty years earlier. Maximilian's journal has never been presented fully in English—until now. This collector's-quality, oversized volume, the first of a three-volume set, draws on the Maximilian-Bodmer Collection at Joslyn Art Museum in Omaha, Nebraska.

German aristocratic naturalist, ethnographer, and explorer whose observations on a trip to the American West in the 1830s provide valuable information about the Plains Indians at that time, Maximilian was the prince of the small state of Neuwied and served in the Prussian army. He undertook explorations in Brazil in 1815–17 and in North America in 1832–34. On the latter journey, he took with him the Swiss artist Karl Bodmer to record the landscapes and peoples they encountered. They traveled from Boston westward along the Ohio River to St. Louis, Missouri, from where they traveled by steamboat up the Missouri River through what are now Missouri, Nebraska, South Dakota, North Dakota, and Montana. The westernmost point they reached on their journey was Fort McKenzie, a trading post in central Montana. Maximilian made copious notes of his contacts with the Mandan, Hidatsa, and other Indian tribes of the Missouri River area, while Bodmer made hundreds of superb watercolors and drawings of the landscapes and the Indians they encountered.

Many exhibitions and books have featured Joslyn's extraordinary holdings of beautifully detailed watercolors and prints by Karl Bodmer. Less attention has been paid to Prince Maximilian's manuscript journals, which the prince collectively called his Tagebuch. These journals, each containing about 300 pages filled with the prince's daily observations on people, places, flora, fauna, and events, written by him in a now obsolete German script and illustrated with his ink and watercolor drawings, are the subject of a complex, multiyear publication project being carried out by Joslyn's Durham Center for Western Studies in partnership with the University of Oklahoma Press.

Volume 1 covers the beginning of the expedition, commencing with a stormy voyage across the Atlantic and ending with the frontier town of St. Louis. Maximilian's primary goal had always been the Western wilderness, but a combination of factors delayed his journey there: the belated delivery of essential supplies, wariness of a cholera epidemic affecting chosen routes of travel, and his own illness that required a lengthy recuperation in New Harmony, Indiana. In the months spent in the east, Bodmer immersed himself in his role as illustrator, producing drawings of the specimens collected for scientific purposes, the natural environment, and of the towns and settlements rapidly overtaking the frontier. His exquisite compositions offer a fascinating window on a brash new nation, from its burgeoning cities on the eastern seaboard to its pioneer farms of Indiana and Illinois.

Maximilian's notes and Bodmer's pictures form an invaluable account of the language, dress, culture, and customs of several Indian tribes that subsequently almost disappeared owing to disease, war, and white encroachment on their lands. Maximilian wrote up his observations in *Reise in das innere Nord-America in den Jahren 1832 bis 1834, 2 vol. (1839–41) (Travels in the Interior of North America)*. An English translation of parts of his field journal was published in *People of the First Man: Life Among the Plains Indians in Their Final Days of Glory* (1976).

The North American Journals offer an incomparable view of the upper Missouri and its native peoples at a pivotal moment in the history of the American West. This meticulous account, newly translated with extensive modern annotation, faithfully reproduces Maximilian's 110 drawings and watercolors as well as his own notes, asides, and appendices. This first volume, which covers May 1832 to April 1833, documents Maximilian's voyage to North America and his first encounters with Indians upon reaching the West. This is an essential resource for nineteenth-century western American history and a work of lasting value. I am looking forward with great anticipation to the concluding volumes. It includes an extensive bibliography, an index to flora and fauna, and a general index. Recommended for all libraries and individuals with an interest in the history of the West or Western art.—*Gary L. Jennings, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

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ASCLEPIADOIDEAE (APOCYNACEAE) COMO MALEZA EN EL CULTIVO DEL AGAVE TEQUILERO (*AGAVE TEQUILANA* VAR. "*AZUL*")

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RESUMEN

Identificamos 15 especies de herbáceas de la subfamilia Asclepiadoideae en 65 puntos de muestreo hechos en campos cultivados con agave azul (*Agave tequilana* F.A.C. Weber var. "*azul*") en el Estado de Jalisco, México. Doce de las especies muestran hábito trepador e impiden el despliegue natural de las hojas del agave, lo que retrasa su crecimiento. Así mismo encontramos un alto endemismo con 11 especies exclusivas a México. Este es el primer estudio que reporta a malezas de la subfamilia Asclepiadoideae en cultivo de agave tequilero.

ABSTRACT

We identify 15 species of herbs in the subfamily Asclepiadoideae in 65 sampling points from fields cultivated with tequila agave azul (*Agave tequilana* F.A.C. Weber var. "*azul*") in the state of Jalisco, México. Twelve of the species show climbing habit on the agave crop which hinders the growth and development of the agave leaves. Likewise, we find a high endemism with 11 of the weedy species restricted to Mexico. This is the first study about weedy members of the subfamily Asclepiadoideae found growing with the tequila agave crop.

INTRODUCCION

El Tequila es originario de Jalisco y su producción esta basada en el cultivo del agave azul (*Agave tequilana* F.A.C. Weber var. "*azul*"), de donde se obtiene la materia prima para la elaboración de esta bebida. Como otros cultivos, el agave puede ver mermado su rendimiento por la acción de varios factores bióticos como plagas, enfermedades causadas por microorganismos y en especial por la interferencia ocasionada por maleza.

El agave por ser un cultivo semiperenne y de crecimiento lento, cuyo ciclo de producción va de seis a nueve años, es más propenso a la invasión por la maleza que otros cultivos; especialmente en los primeros cuatro años de crecimiento. Además, al no estar bajo un sistema de irrigación sufre "stress" hídrico durante los meses de estiaje (Salamanca 2006).

Las plantas invasivas que afectan la producción del agave pueden ser de 3 tipos: a) aquellas que surgen durante el temporal de lluvias y que están caracterizadas por hierbas anuales de diversas familias; b) las que germinan durante la época de otoño-invierno y, c) la maleza perenne, que es la que compite durante más tiempo con el cultivo de agave. La maleza perenne esta compuesta por plantas de especies leñosas, algunas de las cuales son de hábito trepador.

La subfamilia Asclepiadoideae son un buen ejemplo de la exitosa adaptación de vegetales trepadores, ya que en la búsqueda de los requerimientos de agua y nutrientes no solo interfieren en el cultivo compitiendo por estos requerimientos; sino también por luz y espacio, ya que al desarrollar un rápido crecimiento, acompañado del engrosamiento de sus tallos impiden el natural despliegue de las hojas del agave, logrando así retrasar su crecimiento y normal desarrollo (López-Muraira et al. 2007).

Debido al desconocimiento de las plantas invasivas en el cultivo del agave, es importante conocer la diversidad de estas comunidades con la finalidad de entender su estado actual. Este trabajo reporta la pres-

J. Bot. Res. Inst. Texas 2(2): 1341 – 1345. 2008

encia de las especies de la subfamilia Asclepiadoideae que actúan como malezas en el cultivo del agave en el estado de Jalisco, México.

REVISION DE LITERATURA

La definición más aceptada de maleza o mala hierba es “planta que no se desea tener en un lugar y tiempo determinado,” se considera a la maleza como plantas silvestres, no cultivadas, que invaden campos de cultivo o que viven a la orilla de los caminos (Rojas 1984) y en el agave puede interferir en los rendimientos, y ya seca, sigue constituyendo un riesgo al acentuar las heladas y como perdida total del agave en caso de incendios (Luna 2003).

Varias especies de Asclepiadoideae conocidas como lechosas (milkweed) han sido registradas como malezas en diversos cultivos. Así, *Morrenia odorata* Lindl. ha sido reportada por Futch & hall (2003) para cítricos en Florida y *Ampelamus albidus* (Nutt.) Britton para los cultivos de maíz y soya en Virgina, USA por Bradley & Hagood (2001). En Australia, Grice & Martin (2005) reportan a *Calotropis procera* (Aiton) W.T. Aiton y *C. gigantea* (L.) W.T. Aiton como maleza en pastizales y Weston et al. (2005), mencionan a *Vincetoxicum rossicum* (Kleopow) Barbar. (= *Cynanchum rossicum* (Kleopow) Borhidi)) como una maleza introducida de Europa hacia Norteamérica, que se está expandiendo rápidamente. Pero sin duda las especies del género *Asclepias* representan a las malezas más conocidas del grupo de las Asclepiadoideae, ya que de acuerdo con la NAPPO (North American Plant Protection Organization, 2003) hay cerca de 100 especies asociadas con áreas cultivadas, especialmente cereales y cultivos forrajeros, así como en áreas no cultivadas desde Canadá hasta México.

Aunque autores como Hernández et al. (2003), Monroy et al. (2005) y López-Muraira e Iruegas (2006), registran en los cultivos de agave la presencia de diversas especies de malezas trepadoras, entre ellas *Ipomoea purpurea* (L.) Roth, *I. pedatisecta* M. Martens & Galeotti, *Cucumis anguria* L., *C. dipsaceus* C.G. Ehrenb., *Cyclanthera dissecta* (Torr. & A. Gray), *Echinopepon floribundus* (Cogn.) Rose, *E. milliflorus* Naudin, *E. racemosus* (Steud.) C. Jeffrey, *Sicyos deppei* G. Don y *Sechiopsis triqueter* Naudin; sin embargo, solo López-Muraira e Iruegas (2005) reportan 5 especies de la familia Asclepiadaceae; *Dictyanthus pavonii* Decne., *Gonolobus sororius* A. Gray, *Macroscepis obovata* H.B.K., *Matelea sepicola* W.D. Stevens y *Mellichampia rubescens* A. Gray, esto se debe a que muchas veces las malezas trepadoras se confunden entre sí ya que no existe información suficiente para la identificación de éste grupo de plantas.

MATERIALES Y METODO

El trabajo se desarrolló del 2005 al 2006 en muestreos realizados de manera aleatoria a través de campos agaveros de uno a seis años de edad ubicados en 65 localidades del estado de Jalisco. Los muestreos se realizaron en diferentes municipios, comprendidos en las 5 regiones principales productoras de agave: Región Altos Sur, Región Ciénega, Región Valles, Región Centro y Región Sierra de Amula, ubicadas entre los 20° 10.745'N y 104°14.040 W, hasta los 21°05.294 N y 102°48.802 W.

Los ejemplares fueron identificados usando las claves taxonómicas de Rzedowski y Rzedowski 2001; Juárez-Jaimes y Lozada 2003; Rapini 2000; Standley y Williams 1969; Standley 1924 y por comparación con ejemplares depositados en el herbario IBUG, siguiendo el arreglo filogenético propuesto por Liede-Schumann et al. 2005 y Rapini et al. 2006.

RESULTADOS

En los 65 sitios de muestreo realizados durante 2005 y 2006, se colectaron e identificaron 15 especies de plantas de la subfamilia Asclepiadoideae, de las cuales 12 son de hábito trepador, 2 de crecimiento erecto y solo una de ellas presenta hábito rastrero. De acuerdo a Rapini et al. (2006) y Liede-Schumann et al. 2005, se registran 4 subtribus: Asclepiadinae, Cynanchinae, Oxypetalinae y Gonolobinae. Según Rapini et al. (2007) el grupo MOG compuesto por las subtribus Metastelmatinae, Oxypetalinae y Gonolobinae son de origen netamente neotropical y la ausencia de especies de la subtribu Metastelmatinae en el presente trabajo se

TABLA 1. Especies de Ascelepiadoideae reportadas como maleza en el cultivo del agave.

Especie	**Subtribu**	**Origen**	**Hábito**
Asclepias curassavica L.	Asclepiadinae	América tropical	Erecto
Asclepias linaria Cav.	Asclepiadinae	Norteamérica	Erecto
Cynanchum ligulatum (Benth.) Woodson = *Mellichampia rubescens* A. Gray	Cynanchinae	Endémica de México	Trepador
Cynanchum foetidum (Cav.) Kunth	Cynanchinae	Endémica de México	Trepador
Dictyanthus pavonii Decne.	Gonolobinae	Endémica de México	Trepador
Funastrum elegans Schltr.	Oxypetalinae	Endémica de México	Trepador
Funastrum pannosum (Decne.) Schltr.	Oxypetalinae	Endémica de México	Trepador
Gonolobus barbatus (H.B.K.)	Gonolobinae	Mesoamérica	Trepador
Gonolobus grandiflorus (Cav) R. Br. ex Schult. = *Gonolobus erianthus* Decne.	Gonolobinae	Endémica de México	Trepador
Gonolobus jaliscensis B.L. Rob & Greenm.	Gonolobinae	Endémica de México	Trepador
Gonolobus uniflorus H.B.K.	Gonolobinae	Endémica de México	Trepador
Labidostelma guatemalense Schltr. = *Matelea quirosii*	Gonolobinae	Mesoamérica	Trepador
Macroscepis obovata H.B.K.	Gonolobinae	Endémica de México	Trepador
Matelea nummularia Decne.	Gonolobinae	Endémica de México	Rastrero
Matelea sepicola W.D. Stevens	Gonolobinae	Endémica de México	Trepador

debe a que este grupo esta circunscrito a Sudamérica, principalmente Brasil y las islas del Caribe, mientras Oxypetalinae, aunque se distribuye también para Sudamérica, su género *Funastrum* se dispersa mas hacia Centro y Norteamérica, por su parte Gonolobinae, aunque de amplia distribución neotropical se dispersa del noreste de Sudamérica a México hasta Norteamérica, pero no en las islas del Caribe. Las especies de Asclepiadoideae se enlistan el la Tabla 1 y sus fotografías estan en la Figura 1.

DISCUSION

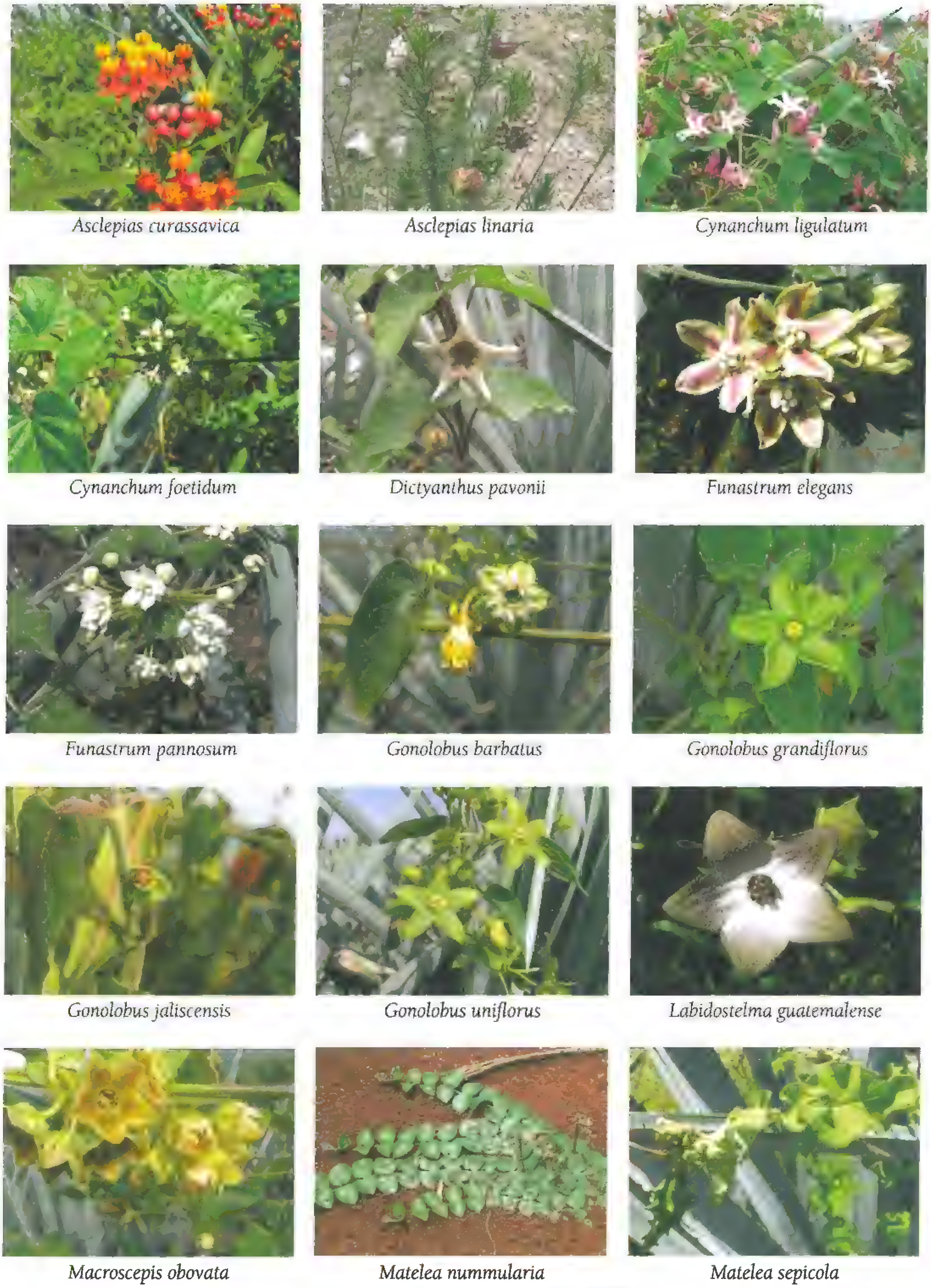
Es notorio encontrar la presencia de 15 especies de Asclepiadoideae como malezas trepadoras en el cultivo del agave, ya que por ser un cultivo perenne, con poca área foliar y un manejo inadecuado de maleza, no solo estas especies sino otras malezas de hábito trepador han sabido adaptarse y transformarse en un problema para los agricultores agaveros. Por otra parte, es importante señalar todas las especies reportadas en el presente estudio son de origen netamente americano y por eso el gran endemismo registrado en el presente estudio con 11 de las 15 especies reportadas como endémicas de México, algunas observaciones hechas durante el transcurso de la presente investigación nos indican que de manera general este grupo de plantas soporta el manejo de control por parte del agricultor agavero a base de aplicaciones de agroquímicos, control manual y mecánico.

CONCLUSIONES

Se reporta la presencia de 15 especies de Asclepiadoideae de las cuales 11 son endémicas a México. De acuerdo a la literatura, por su hábito de crecimiento y las observaciones de campo, a estas especies se les considera como malezas en el cultivo de agave.

AGRADECIMIENTOS

Agradecemos el apoyo recibido de los curadores del herbario IBUG por permitirnos consultar su acervo botánico.



Asclepias curassavica *Asclepias linaria* *Cynanchum ligulatum*

Cynanchum foetidum *Dictyanthus pavonii* *Funastrum elegans*

Funastrum pannosum *Gonolobus barbatus* *Gonolobus grandiflorus*

Gonolobus jaliscensis *Gonolobus uniflorus* *Labidostelma guatemalense*

Macroscepis obovata *Matelea nummularia* *Matelea sepicola*

Fig. 1. Fotografías de las especies de Asclepiadoideae en el cultivo del agave.

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BOOK REVIEW

Peter Bernhardt. 2008. **Gods and Goddesses in the Garden: Greco/Roman Mythology and the Scientific Names of Plants.** (ISBN 0-8135-4266-9, hbk.). Rutgers University Press, 100 Joyce Kilmer Way, Piscataway, New Jersey 08854-8099, U.S.A. (**Orders:** www.rutgerspress.rutgers.edu, 800-848-6224). $24.95, 239 pp., illustrations, 9 1/2" × 6 1/2".

This is a book for the general reader as well as the botanist, anyone who has interest in western classical mythology and in plant taxonomy, and those who may have just casually wondered how plants got their names. Peter Bernhardt of St.Louis University and the Missouri Botanical Garden has given us other books that have piqued and satisfied the curiosities of reader-explorers. In this one he relates the tales of gods and heroes, of kings and queens, of nymphs, satyrs, and centaurs, and then one by one tells how and why taxonomists from Linnaeus to the present have adopted those classical names to different genera of plants. Both the tales and the naming are intriguing and evidence a good deal of exacting research. For example, he points out that with some exceptions nymphs and mortal women often became trees or woody vines (*Daphne*, *Carya*) while demigods and mortal men "dwindle into herbs and wildflowers" (*Crocus*, *Narcissus*).

In his final chapter he expresses hope that modern lack of interest in classical mythology will not impede the continued use of such names and that other cultures, such as Native American or those of the Far East, will also use the names of their own mythological figures in plant taxonomy.

Two comprehensive indices—one general that includes plant common names, taxonomists, and personages from myth, and another of scientific names of plants—make this interesting and readable work into a useful reference for any personal or public library.—*Joann Karges, Librarian (retired), Texas Christian University Library, Box 298400, Fort Worth, Texas 76129, U.S.A.*

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THE SPECIES OF *FUMARIA* (PAPAVERACEAE) IN TEXAS, INCLUDING *F. DENSIFLORA*, FIRST RECORDS FROM NORTH AMERICA

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ABSTRACT

Examination of specimens of *Fumaria* from Texas reveals that *Fumaria officinalis*, *F. parviflora*, and *F. densiflora* have been collected in the state; the latter has not previously been recorded from North America. Notes on distinguishing the species known from Texas are provided, along with a list of representative specimens. Herbarium material from the rest of North America should be re-examined for the presence of species not currently listed for the region.

RESUMEN

El examen de especimenes de *Fumaria* de Texas revela que se han recogido en el estado *Fumaria officinalis*, *F. parviflora*, y *F. densiflora*; esta última no había sido citada en Norte América. Se aportan comentarios sobre cómo distinguir las especies conocidas en Texas, junto con una lista de especimenes representativos. Debería reexaminarse el material de herbario del resto de Norte América para ver la presencia de especies que no están actualmente listadas en la región.

The genus *Fumaria* (formerly placed in the Papaveraceae) comprises some fifty species (Lidén 1986) of annual herbs native to Europe, Africa, and Asia, though many species are now naturalized elsewhere in the temperate zone. The plants are similar in aspect to the more familiar *Corydalis*, having spreading to ascending stems, finely divided leaves, and racemes of strongly zygomorphic, spurred flowers. *Fumaria* differs in having a caducous style (Lidén 1986); white to pink or purplish flowers, often with darker petal tips; and single-seeded fruits.

Fumaria has been known in Texas since at least 1927 [*F. officinalis* L. subsp *officinalis*. Texas. Goliad Co: Roadside, Mar 1927, *Williams 73* (TEX).] Correll and Johnston (1970) listed both *F. officinalis* and *F. parviflora* Lam for the state, as did Jones, et al. (1997). Boufford (1997) listed *F. officinalis*, *F. capreolata* L., and *F. vaillantii* Loisel. for North America and only *F. officinalis* for Texas. He did not include *F. parviflora* for North America, stating that it occurs in North America only as a waif. Since then, most Texas collections have been "pigeonholed" into *F. officinalis*. Billie L. Turner annotated many sheets as *F. officinalis* in 2000, and Tuner et al. (2003) mapped only *F. officinalis* for the state.

In 2007, Richard Lansdown examined TAMU holdings of *Fumaria* and detected *F. densiflora* among them. [Texas. Medina Co: Hondo; Weedy vacant strip at jct. Ave H and 18th Street, 16 Mar 2004, *Reed, Walters, & Corbett 2746* (TAMU)].

We subsequently borrowed specimens of *Fumaria* from Texas from BRIT/SMU, TAES, TEX/LL, and SBSC. Careful examination, with reference to the works of Lidén (1986) and Sell (1993) and to European herbarium specimens, confirmed the presence of multiple collections of *F. officinalis*, *F. parviflora*, and *F. densiflora* from Texas. In one case, two species were collected from the same location within two weeks of one another.

J. Bot. Res. Inst. Texas 2(2): 1347 – 1351. 2008

Additionally, all three species are represented by material collected since 1990. Some populations may be persisting, but it is probable that additional introductions continue to occur.

Identifying specimens of *Fumaria* can be problematic, especially with dry material. Characters traditionally used to separate species are not always reliable (Lidén 1986). Flower color is not definitive, since white flowers may turn pink after pollination; the flowers increase in size during development; and bract vs. pedicel length is variable. The relative sepal length and width, length of fully mature flowers, and fruit characteristics are the most reliable when separating the species known from Texas.

The following key will separate the species known from Texas.

1. Sepals broader than the corolla ______ **F. densiflora**
1. Sepals usually narrower than the corolla (occasionally nearly as broad).
    2.. Fruit broader than long, often truncate or even depressed apically (may be apiculate in subsp. *wirtgenii*, but not keeled or ridged); flowers pink, 7–9 mm long ______ **F. officinalis**
    2. Fruit narrower than long, somewhat keeled apically, often appearing apiculate if viewed from the side; flowers white at anthesis, (4.5–)5–6 mm long ______ **F. parviflora**

A more confident identification of the three species known from Texas can be made by comparing suites of characters (largely from Lidén 1986) as given below. Note that in all species the corollas may be darker (pink to purple or black) at the tips.

Fumaria densiflora DC. Bracts usually longer than the fruiting pedicels; fruiting pedicels strongly thickened; sepals 2–3(–3.5) mm long, 1.5–3 mm broad, usually orbicular to ovate, wider than the corolla, giving unexpanded racemes a papery aspect; corolla 6–7 mm long, pink; fruit apically rounded to obtuse, slightly keeled, rugulose, 2–2.3 mm long and broad (Fig. 1). Images of the Medina Co. plants may be viewed at http://www.csdl.tamu.edu/FLORA/cgi/gallery_query?q=fumaria

Fumaria officinalis L. Bracts ½ as long as to as long as the pedicels; sepals usually narrower than the corolla; corolla (6.6–)7–9 mm long, pink when well-developed; fruit broader than long, rugulose, the apical pits shallow and rounded: subsp. **officinalis.** Sepals (1.6–)2.5–3.5 mm long, 1.5(–1.7) mm broad; fruit 2(–2.4) mm long, (2.25–)2.5 mm wide, apically truncate and appearing depressed or emarginate when viewed from the side: subsp. **wirtgenii** (Koch) Sell. Sepals smaller, 1.5–2 mm long, 0.75–1 mm long; corolla 7–8 mm long, paler than in subsp. *officinalis*; fruit rounded, more strongly rugose, apically essentially subtruncate, rounded and minutely apiculate when viewed from the side, but not keeled, ridged, or emarginate (Fig. 2).

Fumaria parviflora Lam. Bracts usually relatively broad and longer than the pedicels; fruiting pedicels often strongly thickened; sepals 0.5–0.75(–1.8) mm long, 0.4–0.75(–1.6) mm wide, not broader than the corolla; corolla (3.9–)5–6 mm long, white before pollination and often fading pink afterwards; fruit 1.6–2.3 mm long, 1.6–2.5 mm wide, usually longer than wide, apically subglobose to nearly acute, keeled, pointed as seen from the side, the apical pits broad and squarish (Fig. 3).

A FINAL NOTE

It *must* be emphasized that all Texas—and indeed all North American collections!—of *Fumaria* represent naturalized, recently introduced, single-event/impermanent, waif, or otherwise non-native populations. Thus, any new collection of *Fumaria* ought to be identified using keys which include **all** *Fumaria* species. That is to say, a key to European, Asian, and African species ought to be used in addition to a key designed for a particular region. For example, in addition to the species listed here or present in the key in Boufford (1997), *F. bastardii* Bor. and *F. reuteri* Boiss. (= *F. martinii* Clay) have also been recorded in North America (Boufford 1997.) It is entirely possible that additional species will be found in Texas in the future. It is also likely that a thorough re-examination of all North American herbarium specimens would reveal the presence of more taxa than the three listed by Boufford (1997).

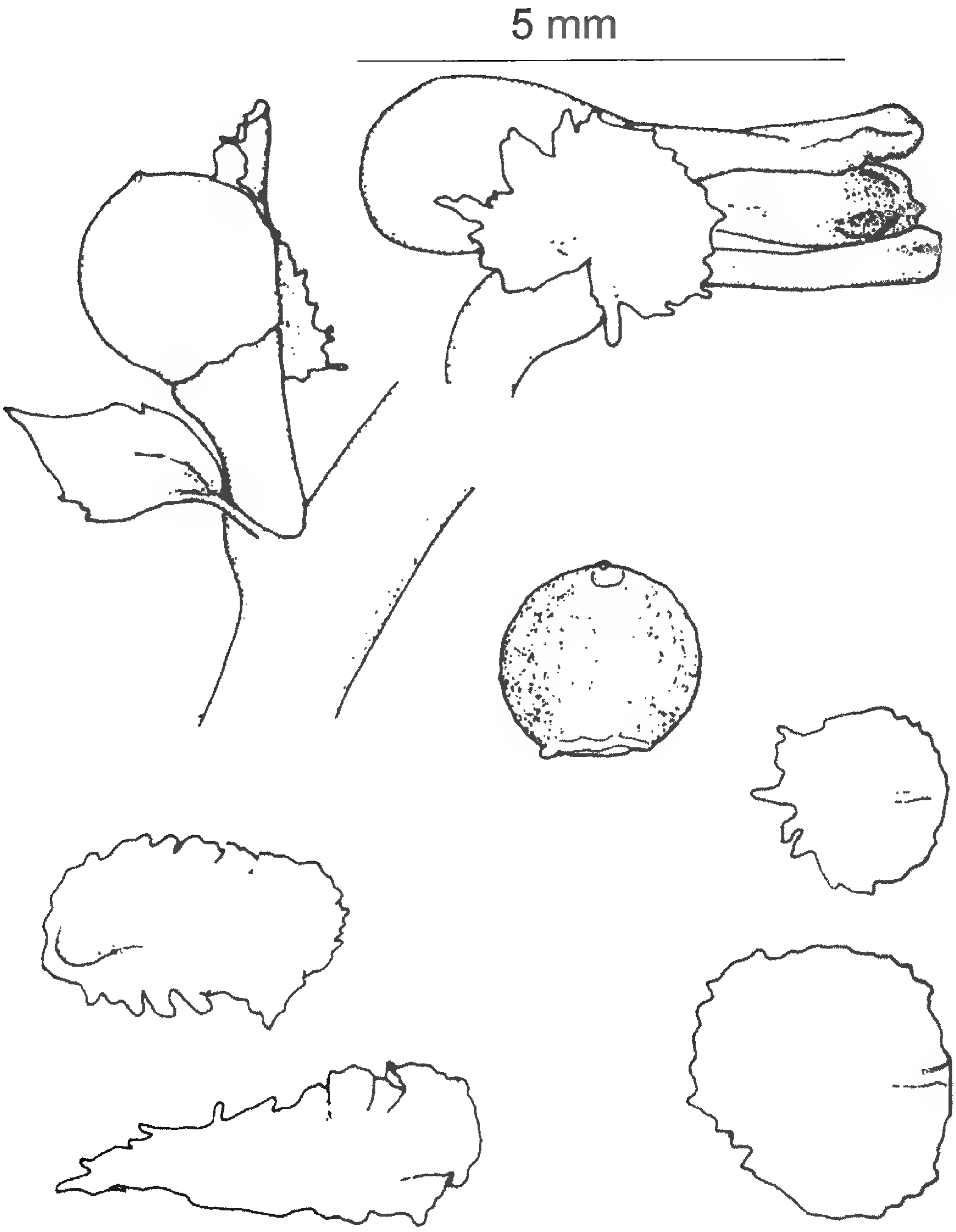

Fig. 1. Flower, fruit, and sepals of *Fumaria densiflora*. Reproduced from Lidén (1986) with permission.

ADDITIONAL REPRESENTATIVE SPECIMENS FROM TEXAS

Fumaria densiflora DC.

Bexar Co.: San Antonio, N side Loop 410 between Espada Rd and Roosevelt Rd (U.S. 281), 1 Apr 1969, *MacEwan s.n.* (SMU). **Dimmitt Co.:** Crystal City, Mar 1931, *Parks s.n.* (TAES); 2½ mi S of Crystal, 1 Apr 1973, *Sturm s.n.* (SMU). **Montgomery Co.:** Kingwood, Kingwood Drive, 15 May 1987, *Opperman s.n.*, (SBSC). **Travis Co.:** Austin, near Texas Memorial Museum, 26 Mar 1956, *McCart 5526* (SMU); Austin, Colorado River Bottom at Montopolis Bridge, 19 Apr 1957, *McCart 6555* (SMU); campus of the University of Texas, Austin, 8 Mar 1955, *Anderson s.n.* (TEX). **Wharton Co.:** 0–0.5 mi E of Kriegel Rd, N of Caney Creek, S of Hwy 1301, 15 Feb 1990, *Hanka 2* (TAMU); Boling, Luper Ranch, 6 Feb 1971, *Fleetwood s.n.* (TEX).

Fumaria officinalis L.

Note.—We attempted to name the better material to subspecies following Lidén (1986). Lidén (1986) and Sell (1993) define the subspecies in different ways, and the characters they use do not always correlate well, so the determinations are provisional. Boufford (1997) noted the occurrence in North America of plants conforming to subsp. *wirtgenii* but did not recognize infraspecific taxa in his account. The specimen cited

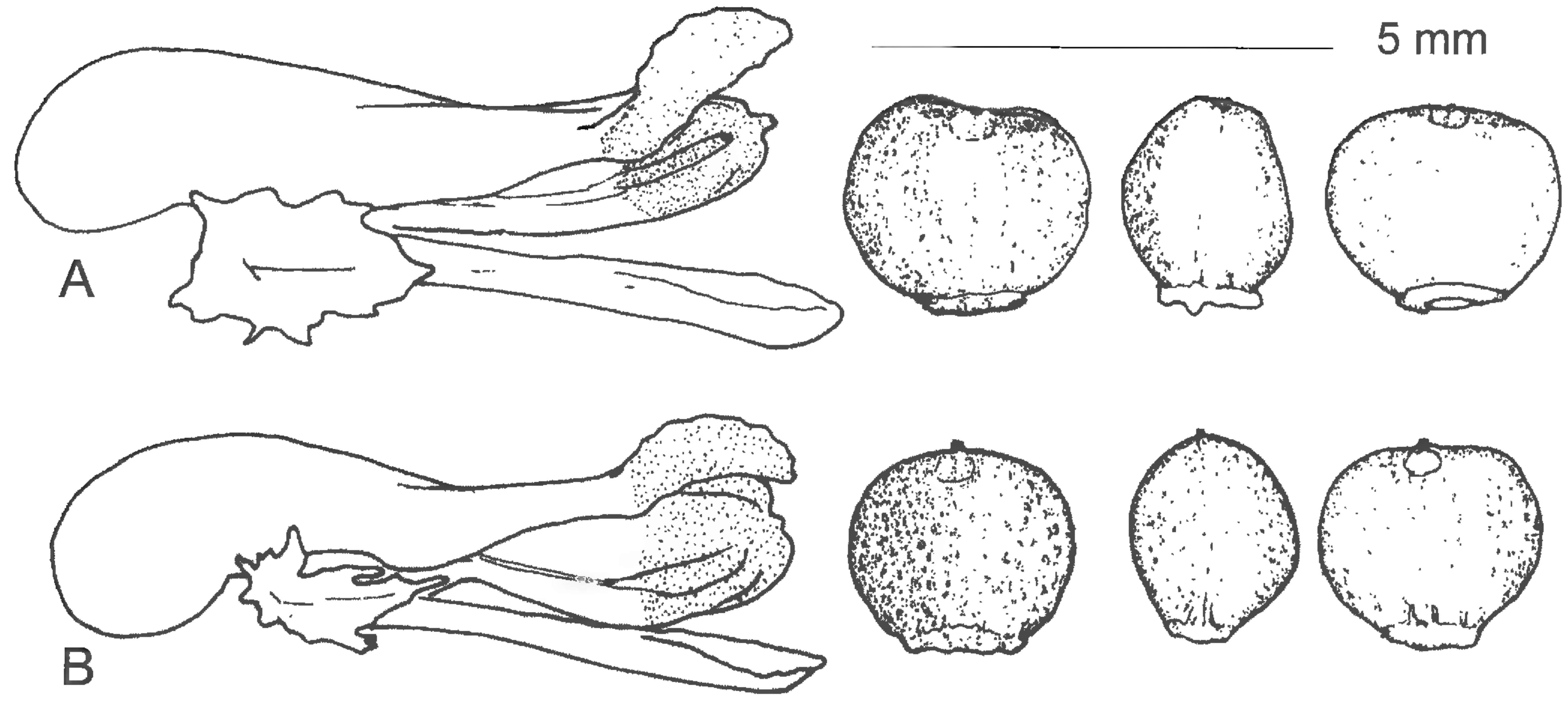

Fig. 2. Flowers and fruit of *Fumaria officinalis*. A. subsp. *officinalis*. B. subsp. *wirtgenii*. Reproduced from Lidén (1986) with permission.

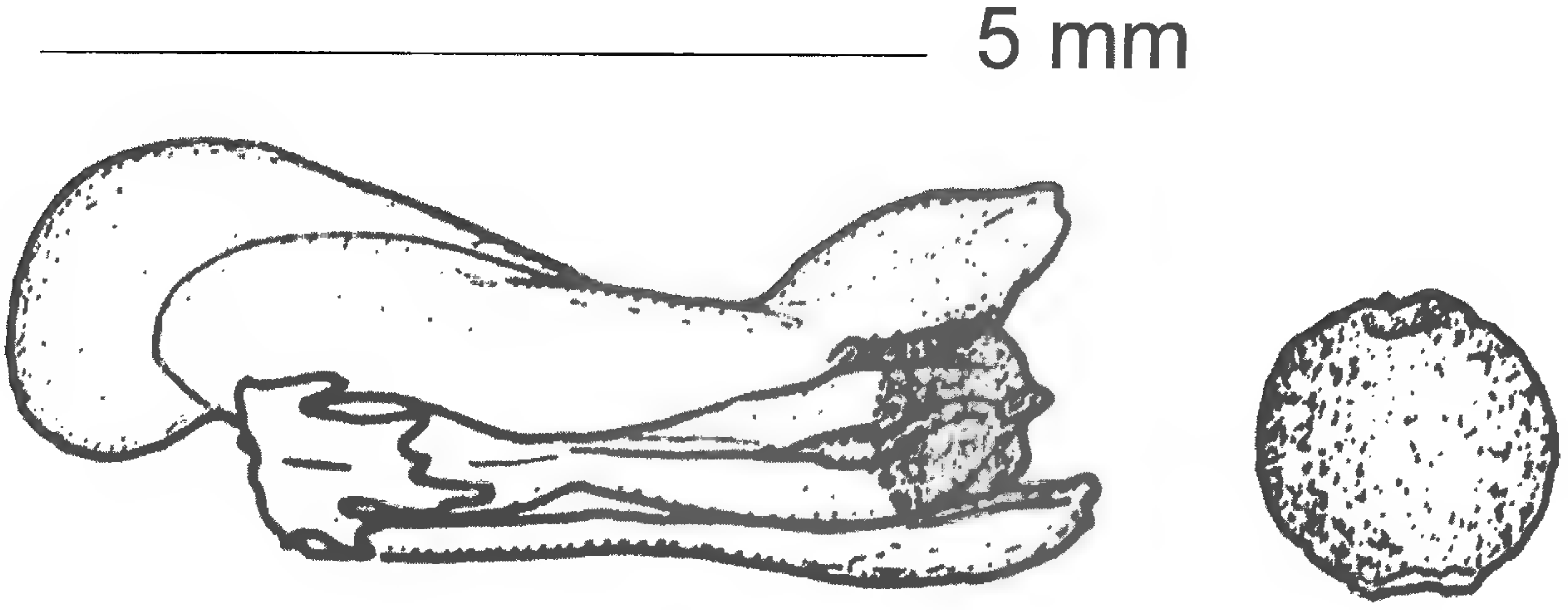

Fig. 3. Flower and fruit of *Fumaria parviflora*. Reproduced from Lidén (1986) with permission.

near the beginning of this paper belongs to subsp. *officinalis*. The two below were undeterminable as to subspecies.

Gillespie Co.: Fredericksburg, 18 May 2003, *Lindeman s.n.* (BRIT). **Smith Co.:** Old Experimental Station 1 mile N by E of Troup (abandoned 1931), 9 Apr 1949, *Cory 55568* (SMU).

Fumaria parviflora Lam.

Bexar Co.: San Antonio, N side Loop 410 between Espada Rd and Roosevelt Rd (U.S. 281), 13 Apr 1969, *MacEwan s.n.* (SMU). **Dimmitt Co.:** Carrizo Springs, 29 May 1948, *Hudspeth 216* (BRIT). **Hidalgo Co.:** McAllen, railroad tracks between Weyheuser and Texas Motor Trailer Court, 3 Apr 1965, *Fleetwood 8067* (TEX); McAllen; N McColl Rd between Violet and Nolana Streets; 26 Feb 1992, *Halse 4440* (BRIT, TAES); Weslaco, 18 Feb 1939, *Friend 27851* (TAES); Weslaco, 18 Feb 1942, *Friend 1949* (SMU); Weslaco, 18 Feb 1942, *Friend 1950* (TEX). **Travis Co.:** NW corner of SE lagoon at Hornsby Bend Sewage Treatment Plant, ca. 1.5 air mi N 32° W of jct. of FM. 973 and TX. Rt. 71, 19 Apr 1983, *Carr 7283* (BRIT). **Williamson Co.:** Anderson Mill, future home sites at SW corner of Lake Creek Parkway and RM 620, 18 May 1982, *Carr 3969* (BRIT).

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BOOK REVIEW

TONY RODD AND JENNIFER STACKHOUSE. 2008. **Trees: a Visual Guide.** (ISBN 978-0-520-25650-7, hbk.). University of California Press, 2120 Berkeley Way, Berkeley, California 94704-1012, U.S.A. (**Orders:** www.ucpress.edu, orders@cpfsinc.com, 800-777-4726). $29.95, 304 pp., color photographs, tables, glossary and index, 11" × 9".

Trees: A Visual Guide is a stunning book with many beautiful pictures, but this book is much more than a coffee table book. Authors Rodd and Stackhouse have given the reader a fantastic guide to all things tree. The opening section "A world of trees," introduces readers to the definition of what is a tree, some tree extremes, and the scientific naming of trees. The form and function of all the parts of trees—ranging from how basic parts function to how growth occurs, as well as survival in extreme environmental conditions—is presented in section two. Closely related to form and function of trees is tree diversity and design, which are explored in section three. The tree diversity and design section also includes a very intriguing and picture-laden section on remarkable trees of the world, including information on such trees as Baobab, cedar of Lebanon, Sequoia, and many more.

The authors next turn, in section four, toward various environmental community types and trees which are typical of such habitats. The ecology of trees and species relationships to the environment, as well as some typical animal species found in such communities, are presented. Ten community types are included in the book. An example of one community type discussed is the Savannas, typical in Africa, which is inhabited by trees such as Umbrella Acacias and animals such as Patas monkeys and giraffes, which have unique relationships with plant species in the region.

The remaining sections are "Trees and the human world" and "An indispensable resource" which explore the many uses humans have for trees and the importance of trees to man. The uses of tree and tree products by man are astounding: food, building supplies, medicine, music, art, transportation, tools, fibers and more. The authors include many environmental benefits, such as biodiversity, flood protection, and soil stabilization, which many readers may not have considered as important benefits of trees.

Trees: a Visual Guide serves as a beautiful presentation of the importance of trees to mankind and the planet. Authors Rodd and Stackhouse have written an easy to enjoy text with color photographs which truly accentuate the information presented. *Trees: a Visual Guide* is a fantastic book for your coffee table, as well as an informative text for those readers interested in all things trees.—*Lee Luckeydoo, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

J. Bot. Res. Inst. Texas 2(2): 1352. 2008

NOTEWORTHY COLLECTIONS FROM THE SOUTHEASTERN UNITED STATES

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ABSTRACT

Fieldwork and herbarium studies have uncovered new or overlooked state records for 23 species: *Agalinis divaricata, Cyperus grayi, Dichanthelium annulum, Echinodorus tenellus, Eleocharis engelmannii, Fimbristylis schoenoides, Gaylussacia nana, Hypericum lloydii, Juncus dudleyi, Juncus interior, Juncus militaris, Juncus nodatus, Juncus subcaudatus, Kalmia angustifolia, Lipocarpha drummondii, Panicum dichotomiflorum* var. *puritanorum, Polygala leptostachys, Pycnanthemum flexuosum, Rhynchospora cephalantha* var. *attenuata, Sagittaria chapmanii, Sclerolepis uniflora, Utricularia juncea, Yeatesia viridiflora*. For 8 other species, the reports herein represent significant distributional records or represent the only known current records for states: *Agalinis filifolia, Aletris lutea, Boltonia diffusa, Fuirena pumila, Juncus articulatus, Leucospora multifida, Polygonum glaucum, Yucca gloriosa*.

RESUMEN

Estudios de campo y de herbario han dado como resultado nuevas citas y otras pasadas por alto de 23 especies: *Agalinis divaricata, Cyperus grayi, Dichanthelium annulum, Echinodorus tenellus, Eleocharis engelmannii, Fimbristylis schoenoides, Gaylussacia nana, Hypericum lloydii, Juncus dudleyi, Juncus interior, Juncus militaris, Juncus nodatus, Juncus subcaudatus, Kalmia angustifolia, Lipocarpha drummondii, Panicum dichotomiflorum* var. *puritanorum, Polygala leptostachys, Pycnanthemum flexuosum, Rhynchospora cephalantha* var. *attenuata, Sagittaria chapmanii, Sclerolepis uniflora, Utricularia juncea, Yeatesia viridiflora*. De otras 8 especies, las citas presentes son importantes o representan las únicas conocidas actualmente para los estados: *Agalinis filifolia, Aletris lutea, Boltonia diffusa, Fuirena pumila, Juncus articulatus, Leucospora multifida, Polygonum glaucum, Yucca gloriosa*.

INTRODUCTION

We have conducted botanical fieldwork and herbarium studies in the southeastern United States coastal plain since 1990. In part, this work was directly related to our occupation as biologists with the North Carolina Natural Heritage Program, in part as a result of contract work to produce status surveys of rare plant taxa for the U.S. Fish & Wildlife Service, and in part related to ongoing taxonomic studies as Research Associates at the University of North Carolina herbarium (NCU). In addition, the senior author has searched many national and local herbaria while preparing county-level range maps for over 1000 endemic coastal plain taxa. These studies have yielded a large number of noteworthy records, some of which have been published (e.g., Sorrie & Leonard 1999; LeBlond & Sorrie 2001).

In the course of this work we visited over two dozen major herbaria with significant holdings of coastal plain plants (see Acknowledgments for those which hold vouchers cited herein). These efforts have resulted in the discovery of new state records for twenty three species of vascular plants in the southeastern United States. For eight other species, the vouchers cited below represent significant range extensions or represent the only known current records in specific states. Scientific names follow published volumes of Flora North America; otherwise they follow Weakley (2007). Herbarium acronyms are those of Holmgren et al. (1990).

ACANTHACEAE

Yeatesia viridiflora (Nees) Small (= *Dicliptera halei* Riddell). A widespread but sparsely distributed species of the Gulf Coastal Plain from northwestern Florida and southwestern Georgia to eastern Texas. The map in Hilsenbeck (1989) depicts a generous range which also includes most of Alabama, Mississippi, and Louisiana, plus a tiny portion of Tennessee. The latter state was listed by Small (1896), but we have seen no specimen

J. Bot. Res. Inst. Texas 2(2): 1353 – 1361. 2008

and *Y. viridiflora* does not appear in the Tennessee Atlas (Chester et al. 1997). In Alabama (Alabama Flora Committee 2004) and Louisiana (Thomas & Allen 1996) this species is decidedly local, being absent from large portions of each. We can find no records for Arkansas (Smith 1988) and Mississippi (Kartesz 1999); the following are the first records for these states.

Voucher specimens: **ARKANSAS: Dallas Co.:** fertile wooded hillsides, Thatcher's Bluff, P.O. Sardis, elev. 250, 27 Jun 1964, *D. Demaree 50592* (BRIT). **MISSISSIPPI: Wayne Co.:** Bucatunna Creek ca. 7 mi E of Waynesboro, T8N R5W, 11 Oct 1970, *K.E. Rogers 4777 with R. Watson* (MISS).

AGAVACEAE

Yucca gloriosa L. This species of maritime habitats is uncommon from North Carolina to Georgia, and rare from Florida to Louisiana. This is apparently the third county of occurrence in Florida (Atlas of Florida Vascular Plants 2007) and the only one from the west coast of the peninsula.

Voucher specimen: **FLORIDA: Pinellas Co.:** occasional in foredunes, west coast of Caladesi Island, 2 Jun 1963, *R.H. Wagner 876* (DUKE).

ALISMATACEAE

Echinodorus tenellus (Mart.) Buch. (= *E. parvulus* Engelm.). Haynes and Hellquist (2000) map this diminutive annual in ten states (but read Va. for Vt.). However, it occurs in seven other states as documented by Tatnall (1946) for Delaware, Jones (2005) for Kentucky, Thomas and Allen (1993) for Louisiana, Steyermark (1963) for Missouri, Stone (1911) for New Jersey, Taylor and Taylor (1994) for Oklahoma, and LeBlond and Sorrie (2001) for North Carolina. The following are the first published records for Arkansas and Mississippi.

Voucher specimens: **ARKANSAS: Baxter Co.:** WSW of Mt. Home, small stock pond along roadside, 26 Oct 1974, *B.L. Lipscomb 992* (BRIT). **MISSISSIPPI: Lamar Co.:** 3 mi W of Purvis, abundant on edge of lake, 29 Aug 1973, *K.E. Rogers 9223* (GA, NCU, VDB); same location (Mossy Pond), 1 Sep 1998, *B.A. Sorrie 9924 with S.W. Leonard* (GH).

Sagittaria chapmanii (J.G. Smith) C. Mohr. Haynes and Hellquist (2000) treat this entity as *S. graminea* Michx. ssp. *chapmanii* (J.G. Smith) R.R. Haynes and C.B. Hellquist, but analyses of allozyme variation by Hauber and Lege (1999) argue convincingly that *S. graminea* and *S. platyphylla* (Engelm.) J.G. Smith are more closely related to each other than either is to *S. chapmanii*. We therefore follow Weakley (2007) in treating *S. chapmanii* as a full species. This species is notable among our *Sagittaria* in having branched inflorescences. Haynes and Hellquist (2000) map it in South Carolina, Georgia, Florida, and Alabama; LeBlond and Sorrie (2001) document it from North Carolina; Majure (2007) reports it from Mississippi. These are the first records for Louisiana, Texas, and Arkansas.

Voucher specimens: **ARKANSAS: Bradley Co.:** Johnsonville Prairie, 5.9 mi SW of Johnsonville on unnamed road, Sec. 23, T16S, R9W, flat open prairie and sparse woods, 5 Aug 1984, *R.D. Thomas 90284* (NLU); **Calhoun Co.:** along dirt road in flat pine woods 1 mi S of Arkansas 4, ca. 6 mi W of Hampton and US 167, 30 May 1990, *R.D. Thomas 118250* (NLU). **LOUISIANA: Allen Parish:** wood road 1 mi W of highway 165, 1 mi N of Oakdale, 17 Aug 1979, *S. Darwin 1973 with E. Sundell* (NLU); **Beauregard Parish:** sandy roadside 3 mi S of De Ridder, 11 Jul 1970, *Northwest State College Biology Class s.n.* (NLU); **Bossier Parish:** ca. 2 mi N of Benton, water of ditch along road, 7 Aug 1938, *D.S. Correll 10131 with H.B. Correll* (DUKE); **Livingston Parish:** mixed forest along Big Branch, SE of Holden, 19 Mar 1975, *C.M. Allen 6426* (DUKE); **Natchitoches Parish:** roadbank at Cypress Branch, 4 mi W of Mora, 30 Apr 1972, *R.D. Thomas 28600* (NLU); **Rapides Parish:** 5 mi S of Pineville, shallow water of roadside pond in pine woods, 21 Oct 1966, *J.W. Thieret 25012* (DUKE); **St. Tammany Parish:** pine woods W of Louisiana 41, E of Lacombe Bayou, N of Hickory Fire Tower, 19 Jun 1976, *R.D. Thomas 49523* (NLU); ca. 5 mi NW of Slidell, disturbed largely pine woods in Sec. 26, 12 Jun 1968, *J.W. Thieret 29206* (DUKE). **TEXAS: Grimes Co.:** near highway 1774, 7 mi SE of Plantersville, fairly common in ditch near railroad tracks, no standing water, 1 Jul 1969, *J.J. Sperry s.n.* (BRIT).

ASTERACEAE

Boltonia diffusa Elliott. Radford et al. (1968) include this species within their concept of *B. caroliniana* (Walter) Fernald, but Karaman-Castro and Urbatsch (2006) recognize them as distinct species and map *B. diffusa* in North Carolina and southward. We are aware of only a single historical specimen in North Carolina: *H.E. Ahles 19986* (NCU) from Stanly County in 1956. The following vouchers provide current documentation. Since all records are from highly disturbed habitats, the native/alien status of this species in the state is uncertain.

Voucher specimens: **NORTH CAROLINA: Anson Co.:** abundant in disturbed roadsides, narrow powerline, and loblolly pine plantation, SR 1121 N of Leggett Branch, 11 Oct 2007, *B.A. Sorrie 12047* (NCU); **Moore Co.:** abundant in dry clearing in floodplain of Little River just downstream from confluence with Nick's Creek, 21 Aug 2007, *B.A. Sorrie 12003* (NCU, US).

Sclerolepis uniflora (Walter) B.S.P. A coastal plain endemic of periodically inundated wetlands, this species ranges from New Hampshire to Florida and Alabama (Lamont 2006). *Sclerolepis uniflora* is not included for Louisiana by Thomas and Allen (1993) or for Mississippi by Kartesz (1999). The following records establish its presence in Louisiana and Mississippi.

Voucher specimens: **LOUISIANA: St. Tammany Parish:** extensive mats growing in shallow water, woods road through wet slash pine-pond cypress forest, Talisheek Wetlands Preserve, 2 Jun 1999, *L. Smith s.n.* (LSU, NLU). **MISSISSIPPI: George Co.:** 9.1 mi E of route 63 on US 98, savanna-like area, 26 May 1973, *D. Boufford 9441 with H.E. Ahles* (GH).

CYPERACEAE

Cyperus grayi Torr. Gray's umbrella-sedge occurs in dry sandy woods and coastal dunes primarily along the Atlantic and Gulf Coastal Plain from New Hampshire to Alabama (Kartesz 1999) and Mississippi (Radford et al. 1968). It is indicated as absent from Florida by Kartesz (1999), Tucker, Marcks, and Carter (2002), USDA NRCS (2007), and the Atlas of Florida Vascular Plants (2007). This is the first record for Florida.

Voucher specimen: **FLORIDA: Liberty Co.:** Apalachicola Bluffs and Ravines Preserve near Bristol, 4 Jun 1991, *R.J. LeBlond 2171* (FSU).

Eleocharis engelmannii Steud. A widespread species in the United States and southern Canada, but rarely collected in the southern Atlantic and Gulf Coastal Plains. Thomas and Allen (1993) do not include it for Louisiana; this is the first record for that state.

Voucher specimen: **LOUISIANA: Jeff Davis Parish:** along West Bayou Lacassine, 23 Sep 1967, *J.W. Thieret 27938* (DUKE).

Fimbristylis schoenoides (Retz.) Vahl. This fimbry sedge, introduced from Asia, has been documented from Georgia and Florida west to Louisiana (Kral 2002a). This is the first known North Carolina collection.

Voucher specimen: **NORTH CAROLINA: Hyde Co.:** Ocracoke Island, in maritime wet grassland along N side of NC 12, 0.1 mi E of Cape Hatteras National Seashore boundary sign just SE of Ocracoke village; 17 Oct 2005, *R.J. LeBlond 6154* (NCU).

Fuirena pumila (Torr.) Spreng. This specialist of ponded depressions, sinkhole ponds, and glacial kettle-hole ponds is scattered along the Atlantic and Gulf states from Massachusetts to Florida and Texas, with disjunctions to the Great Lakes region. Majure (2007) reports it from two Mississippi counties. This is the third record for Mississippi.

Voucher specimens: **MISSISSIPPI: Lamar Co.:** Mossy Pond, 3 mi W of Purvis, 1 Sep 1998, *B.A. Sorrie 9928 with S.W. Leonard* (GH, MISS, NCU).

Lipocarpha drummondii (Nees) G.C. Tucker. Tucker (2002) does not include Louisiana in the range of this diminutive annual, and Thomas and Allen (1993) do not include it. The specimen cited below differs from *L. micrantha* (Vahl) G.C. Tucker in possessing second scales 0.7 mm long. This is the first record for Louisiana.

Voucher specimen: **LOUISIANA: Caddo Parish:** woods and edge of wood along railroad, Section 6, ca. ¾ mi SE of Reiser, 7 Jul 1970, *J.W. Thieret 32137* (NCU).

Rhynchospora cephalantha A. Gray var. **attenuata** Gale. Kral (2002b) synonymizes this variety under nominate *R. cephalantha,* which ranges from New York to Florida and Texas. However, LeBlond in Weakley (2007) recognizes it as distinct, due to its narrower and shorter achenes and its tendency to produce hemispherical heads (vs. subglobose to globose). In addition, var. *attenuata* inhabits wooded streamheads, baygalls, and semi-open seepage slopes, rather than savannas, marshes, and other open habitats occupied by var. *cephalantha*. In our experience var. *attenuata* is not a rare plant, but merely overlooked. Gale (1944) cites specimens of var. *attenuata* from North Carolina, South Carolina, Alabama, and Mississippi. Thomas and Allen (1993) do not mention this variety, even in synonymy, for Louisiana. This is the first record for that state.

Voucher specimens: **LOUISIANA: Vernon Parish:** woods along unmarked road at Drake's Creek just S of Fort Polk in Kisatchie National Forest, ca. 1.5 mi E of Johnsonville Church and Louisiana route 10, 7 Sep 1987, *R.D. Thomas 101449 with C.M. Allen* (NLU).

ERICACEAE

Gaylussacia nana (A. Gray) Small. Luteyn et al. (1996) list this shrub for Alabama, Florida, Georgia, and Tennessee. This species is not listed for North Carolina (Radford et al. 1968), Mississippi (Kartesz 1999), or Louisiana (Thomas and Allen 1993); these are the first records. The Louisiana specimen does not give parish name and it is unlikely to have been collected in Orleans Parish, but rather in adjacent St. Tammany, Tangipahoa, or Washington Parishes where suitable pinelands occurred.

Voucher specimens: **LOUISIANA:** "New Orleans," 1832, *T. Drummond s.n.* (GH). **MISSISSIPPI: Harrison Co.:** Handsboro, low wet pine woods, 29 May 1951, *D. Demaree 30621* (GH); Mississippi City, low wet woods, 1 Jun 1951, *D. Demaree 30677* (DUKE); sandy open pine ridges, Mississippi City Post Office, 9 Jun 1954, *D. Demaree 35539* (GH); DeSoto National Forest, N of Krohn cemetery, W of Old Biloxi Road, rolling dry longleaf pine upland, 18 Apr 1997, *B.A. Sorrie 9158* (GH, MISS, NCU); DeSoto National Forest, N of White Star Road, hilltop under longleaf pine, oak, and dogwood, 22 May 1997, *B.A. Sorrie 9248* (MISS, NCU); **Jackson Co.:** Ocean Springs, 4 Apr 1889, *F.S. Earle s.n.* (DUKE); Ocean Springs, 18 Jun 1895, *J. Skehan s.n.* (GH); Fontainebleau Point, 11 Jun 1954, *D. Demaree 35561* (GH); Cedar Creek NE of Orange Grove, local in sandy pine woods near low bog, 15 Apr 1964, *S. McDaniel 4185* (FSU, IBE); **NORTH CAROLINA: New Hanover Co.:** pine/scrub oak sandhill habitat W of Wilmington Beach, 22 Jun 1997, *R.J. LeBlond 4761 with A.S. Weakley* (FLAS); same location, 23 Oct 2002, *R.J. LeBlond 5748* (NCU). The 1997 record was erroneously reported as *G. tomentosa* (A. Gray) Pursh ex Small by LeBlond and Sorrie (2001).

Kalmia angustifolia L. The two eastern North American "sheep laurels," *Kalmia angustifolia* and *K. carolina* Small, were treated as full species by Southall and Hardin (1974) but as varieties of *K. angustifolia* by Ebinger (1974). The ranges of these taxa overlap in a small area of southeastern Virginia. Recent field and herbarium studies suggest that hybridization is rare, which supports species status (Sorrie and Weakley ms.). Heretofore, *K. angustifolia* had not been reported from North Carolina (Radford et al. 1968); the following provides documentation.

Voucher specimens: **NORTH CAROLINA: Gates Co.:** Wyanoke area, 3.5 km NE of Riddicksville, area of deep sand deposits, abundant understory species, 9 Aug 2005, J. Townsend 3486 (NCU, VPI); same data but 3.9 km NE of Riddicksville, J. Townsend 3487 (NCU, VPI).

HYPERICACEAE

Hypericum lloydii (Svenson) W.P. Adams. This dwarf shrub occurs in the lower piedmont and upper coastal plain from North Carolina to Alabama. The Atlas of the Virginia Flora (2007) does not include *H. lloydii*; this is the first record for that state.

Voucher specimen: **VIRGINIA: Mecklenburg Co.:** roadside of Virginia route 58, 7 Jul 1967, *W.D. Seaman 7460* (NCU).

JUNCACEAE

Juncus articulatus L. A northern species that in eastern United States ranges south to Pennsylvania and New Jersey, with several records in the mountains of Virginia, West Virginia, and Kentucky (Brooks and Clemants 2000). The following provides label data for a curiously disjunct record from the seacoast of North Carolina. Although the specimen was annotated correctly in 1954 by W.T. Batson and included in Radford, Ahles, and Bell (1968), details of this record have not been published previously.

Voucher specimens: **NORTH CAROLINA: Dare Co.:** marsh at Cape Hatteras, 23 May 1954, *A.E. Radford 8188* (NCU).

Juncus dudleyi Wiegand. This species of calcareous soils is not mapped in the deep southern United States by Brooks and Clemants (2000). However, the Alabama Flora Committee (2004) maps it in Bullock and Montgomery Counties. Thomas and Allen (1993) omit it from Louisiana; the following is the first documentation for Louisiana.

Voucher specimens: **LOUISIANA: Ouachita Parish:** cleared lots and woods off Lakeside St. in new Waterside Park Subdivision, E of Monroe, 7 May 1967, *R.D. Thomas 2614* (NCU); **Winn Parish:** Cedar Creek, 3 mi E of Winnfield, open *Gleditsia* wood, 24 Apr 1955, *G.R. Cooley 3686 with L.J. Brass* (NCU).

Juncus interior Wiegand. This is a widespread midwestern species of prairies and prairie-like habitats. Brooks and Clemants (2000) map it in adjacent Louisiana, Arkansas, and Tennessee, but not Alabama and Mississippi. The Alabama Flora Committee (2004) maps it in Barbour County; Kartesz (1999) does not map it in Mississippi. This is the first record for Mississippi and second for Alabama.

Voucher specimens: **ALABAMA: Perry Co.:** four mi S of Marion on highway 5, open prairie, 15 May 1969, *J.L. Thomas 2066* (NCU). **MISSISSIPPI: Bolivar Co.:** 5 mi W on Old Pace Road, P.O. Cleveland, 26 May 1960, *H.L. Jacob 1351* (NCU).

Juncus militaris Bigelow. This northeastern species of lakes and ponds ranges south to Delaware, Maryland, and northern Indiana (Brooks and Clemants 2000). This is the first record for North Carolina, a disjunction of some 380 km. Plants are abundant in a dense but narrow band in 0.3–0.7 m of water in a very large Carolina bay lake.

Voucher specimens: **NORTH CAROLINA: Washington Co.:** Pettigrew State Park, SE side of Lake Phelps, emergent from shallow water with *Eriocaulon aquaticum* and *Xyris smalliana*, 4 Sep 2005, *B.A. Sorrie 11715 with L. Mize, J. Mize* (GH, NCSC, NCU, US).

Juncus nodatus Coville. This species of the southern midwest United States is notable for the ring-like bands on leaves at each cross-partition. These are the first records for Mississippi.

Voucher specimens: **MISSISSIPPI: Jackson Co.:** wet ditch, Ocean Springs, 9 May 1970, *K.E. Rogers 3246-B* (NCU); **Rankin Co.:** E shore of Barnett Reservoir between Safe Harbor Marina and Pelahatchie Bay area, locally abundant, 7 Oct 1972, *K.E. Rogers 8812-A* (NCU).

Juncus subcaudatus (Engelmann) Coville & S.F. Blake. This species is a relative of *J. canadensis* J. Gay, but nearly confined to the Appalachian Mountain system. Radford et al. (1968) do not include it for South Carolina; this is the first record.

Voucher specimen: **SOUTH CAROLINA: Oconee Co.:** Whitewater River NW of Jocassee, 2 Sep1956, *A.E. Radford 17875* (NCU).

LAMIACEAE

Pycnanthemum flexuosum (Walter) B.S.P. This coastal plain endemic ranges from Virginia to Alabama (Kartesz 1999). This is the first record for Mississippi. The specimen was determined by H.A. Gleason in 1960 as *P. setosum*, a closely related congener, but the specimen possesses narrow leaves characteristic of *P. flexuosum* (note: the drawings of these two species are reversed in Gleason 1952). It was on this collection that Kartesz (1999) based his Mississippi occurrence of *P. setosum*; therefore the latter record should be deleted, leaving *P. setosum* with a range of New Jersey to Florida.

Voucher specimen: **MISSISSIPPI: Pearl River Co.:** moist sandy grassy flat along railroad in cleared longleaf pineland, 2 mi S of Picayune, 26 May 1956, *J.D. Ray, Jr. 6488* (NCU).

LENTIBULARIACEAE

Utricularia juncea Vahl. A New World species of wet acidic seepages, pine savannas, pond margins, and boggy wetlands, *U. juncea* in North America is restricted to the coastal plain from Long Island, New York to southern Florida and eastern Texas. This is the first record for Maryland, the species being omitted by Brown and Brown (1984).

Voucher specimen: **MARYLAND: Prince George Co.:** Suitland Bog, 13 Aug 1921, *P.T. Newbold 708* (MO).

LILIACEAE

Aletris lutea Small. A widespread species of pine savannas and flatwoods, ranging from southern Georgia to south Florida to southeastern Louisiana. According to Thomas and Allen (1993), this is the first record from west of the Mississippi River.

Voucher specimen: **LOUISIANA: Vernon Parish:** Kisatchie National Forest, silt loam, level, burned over, T1S R8W Sec.14, 2 May 1940, *E.L. Stone 21* (FSU).

OROBANCHACEAE

Agalinis divaricata (Chapman) Pennell. Outside of Florida, this species was heretofore known only from three southern Alabama counties (specimens at FSU, GH, NCU). Jones and Coile (1988) do not include it for Georgia; this is the first published record for that state.

Voucher specimen: **GEORGIA: Decatur Co.:** in dry sandy soil, E side of airstrip road at L/S [Lake Seminole], 15 Sep 1973, *A. Gholson s.n.* (FSU).

Agalinis filifolia (Nuttall) Raf. This species ranges throughout Florida and southeastern Georgia. Pennell (1929) cited an old Gates specimen from Alabama that lacked location data; the Alabama Flora Committee (2004) mapped it in Baldwin County. These are the first modern records for Alabama.

Voucher specimens: **ALABAMA: Baldwin Co.:** dry sandy open woods N of sand dunes along Gulf of Mexico, highway 180 between Gulf Shores and Fort Morgan State Park, 7 Oct 1967, *M.H. Lelong 3850* (NCU); same place and date, *B.E. Wofford 10192* (NCU); Bon Secour National Wildlife Refuge, W of Little Lagoon, 29 Sep 1997, *B.A. Sorrie 9573 with R.J. LeBlond* (AUA, GH, NCU).

PLANTAGINACEAE

Leucospora multifida (Michx.) Nuttall. *Leucospora* prefers moist to wet sandy or muddy shores and depressions, including disturbed habitats. It is widespread in eastern North America, but rare along the Atlantic Coastal Plain, with the North Carolina population disjunct from the panhandle of Florida. This is the only known specimen for North Carolina. Kartesz (1999) maps it in North Carolina and cites Weakley (1997) as the source; we here give full details of this record.

Voucher specimen: **NORTH CAROLINA: Carteret Co.:** Cherry Point Marine Corps Outlying Field Atlantic, NW of the community of Atlantic, in borrow pond within NW corner of runway complex, 2 Sep 1993, *R.J. LeBlond 3544* (NCU).

POACEAE

Dichanthelium annulum (Ashe) LeBlond. Within the *Dichotoma* group, *D. annulum* is one of the most distinct taxa (LeBlond 2001), with its relatively tall stature, soft villous foliage, short hairy upper internodes, minute ligules, and bearded nodes. Freckmann and Lelong (2003a) synonymize it under *D. dichotomum* (L.) Gould ssp. *mattamuskeetense* (Ashe) Freckmann & Lelong, but that taxon differs in its glabrate leaves, larger spikelets, coastal plain distribution, and affinity for wet acidic soils. *Dichanthelium annulum* ranges from New Jersey to Missouri, south to Georgia and Mississippi; it inhabits open woodlands, glades, and barrens, often in high pH substrates. This represents the first collection in North Carolina since 1968.

Voucher specimen: **NORTH CAROLINA: Stanly Co.:** Morrow Mountain State Park, north slope of Biles Mountain, common in graminoid dominated glade-like woodland under *Quercus alba, Q. stellata, Carya glabra, Cercis canadensis, Pinus echinata*, 1 Jun 2007, *B.A. Sorrie 11963* (NCU).

Panicum dichotomiflorum Michx. var. **puritanorum** Svenson. This represents the first vouchered report of this rare grass from Delaware and possibly the entire Delmarva Peninsula. *Panicum dichotomiflorum* var. *puritanorum* ranges along the coastal plain from Nova Scotia and New Hampshire south to Virginia, with disjunct occurrences around Lake Michigan in Indiana and Illinois. It is found primarily in wet sands and organic soils of seasonally exposed pond and lake shores. It was previously reported from Delaware by R.A. Ralph in an undated manuscript at the University of Delaware (Kartesz 1999). This manuscript was prepared sometime prior to 1992 while Ralph was a student at the College of Marine Studies in Lewes (McAvoy pers. comm.). No voucher specimen for this report has been located. Plants from Delaware northward typically have slender culms 0.3–6 dm long and leaves 1–8 mm wide. Plants with floral characters of var. *puritanorum* but with stout culms 0.8–2 m long and leaves 7–25 mm wide (similar to var. *dichotomiflorum*) occur in bottomlands in southeastern Virginia, and have been recognized as *P. dichotomiflorum* var. *imperiorum* Fernald (Fernald 1942). These plants are currently regarded as belonging to var. *puritanorum* by Weakley (2007) and presumably are the source of the inclusion of Virginia within the range by Freckmann and Lelong (2003b). The Virginia plants need further study.

Voucher specimen: **DELAWARE: Sussex Co.:** Huckleberry Pond, SE of Milford and NW of Broadkill Beach, 17 Sep 1991, *R.J. LeBlond 2554 with B.A. Sorrie and W.A. McAvoy* (DOV).

POLYGALACEAE

Polygala leptostachys Shuttleworth. This essentially Floridian species is rare outside of that state, known from only a few specimens in Georgia (Jones and Coile 1988) and Mississippi (Kartesz 1999). This is the first published record for Alabama. Al Schotz (pers. comm.) informed us that he has found it in Baldwin and Geneva Counties.

Voucher specimen: **ALABAMA: Escambia Co.:** Conecuh National Forest, N of road to Hines Lake, dry to xeric knoll in longleaf pine-wiregrass-shrub flatwoods, 6 Aug 1996, *B.A. Sorrie 8974* (AUA, GH).

POLYGONACEAE

Polygonum glaucum Nutt. This plant of maritime foredunes and accreting beaches ranges from Massachusetts to north Florida, almost exclusively on the Atlantic coast. The Atlas of Florida Vascular Plants (2007) maps it only in Duval and Gulf Counties. This is the second record for the Gulf coast of Florida.

Voucher specimen: **FLORIDA: Franklin Co.:** Saint Vincent Island, open dry sand dunes, 25 Jun 1936, *D.S. Correll 5583* (DUKE).

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BOOK REVIEW

SUZANNE LE-MAY SHEFFIELD. 2006. **Women and Science: Social Impact and Interaction.** (ISBN 978-0-8135-3737-5, hbk.). Rutgers University Press, 100 Joyce Kilmer Avenue, Piscataway, New Jersey 08854-8099, U.S.A. (**Orders:** www.rutgerspress.rutgers.edu). $29.95, 407 pp., numerous black/white images and biographical asides, 7" × 10".

Women and Science: Social Impact and Interaction is separated into seven chapters with an introduction on Marie Curie's influence on today's science. The book also includes an extensive section on resources that is divided into six distinct sections. These include a glossary, chronology, documents, bibliography, index, and author information.

This was a very interesting book that dives into the details of women's struggle in science throughout history. The author provides insight into how women received less education in the early 17th Century and were merely seen as aides to their husbands or partners. In the 18th Century, the role of women in science began to change. They were encouraged to learn science in hopes of advancing their abilities to socialize and teach their children proper science in the home. During this time many women became naturalists and took more interest in the world and science that surrounded them. One of the leading scientific topics that drew much attention from women was botany. Many books written by women at time pertained to plants and gardening. Women also gained access into the field of science by gaining honorary membership into particular social societies.

By the late 19th Century, much of the available education at the primary level was not adequate for women to compete at higher educational levels. Society allowed women to attend universities and sit in on lectures, but they were not allowed to receive doctorates in science. It wasn't until the 20th Century when it became more acceptable for women to be allowed to graduate with advanced degrees. During this time, the number of women interested in science and eager to seek degrees in this field grew exponentially. However, as the number of female scientists climbed, male counterparts erected barriers to staunch the advancement of women to the highest positions of science. There has been a decline in these barriers throughout time, and several stereotypes have been dissolved, allowing women mostly equal opportunities. But women today still face many struggles to obtain higher positions in science and to maintain their value there.

Sheffield's book is a great find for those interested in learning more about women's role in science and the history behind their struggles to compete and succeed in a man's world. The inclusion of historical asides on particular researchers and a chronological listing of important women in science enhanced the overall impact and utility of the book.—*Keri McNew, MS Biology, Programs Manager, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

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ANALYSIS OF THE COMPLETENESS OF VASCULAR PLANT RECORDS IN FLORIDA

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ABSTRACT

Using the species-area relationship formula $S=CA^z$, we predicted the species richness of vascular plants for each county in Florida. The predicted species richness value of each county was then compared to the documented species richness value for each county gathered from herbaria records. Results indicate that 67% of the Florida counties have documented species richness values that matched or exceeded predicted values. The remaining counties (33% of the Florida) lack adequate documentation of species richness and thereby constitute data-gaps in the state's floristic inventories.

Key Words: biodiversity, Florida, herbarium, inventory, mapping, modeling, species area relationship, species richness, vascular plants

RESUMEN

Usando la fórmula de la relación especies-área $S=CA^z$, se predijo la riqueza en especies de plantas vasculares de todos los condados de Florida. El valor de riqueza de especies de los condados se comparó con el valor de riqueza documentado de cada condado obtenido de los registros de herbarios. Los resultados indican que el 67% de los condados de Florida tienen valores de riqueza de especies documentados que coinciden o exceden los valores pronosticados. Los restantes condados (33% de Florida) carecen de la documentación adecuada de riqueza de especies y por ello constituyen lagunas de datos en los inventarios florísticos del estado.

Williams and Lutterschmidt (2006) presented a herbarium assessment model that provides a mathematical and objective approach to identifying data gaps in documented species richness determined from a state's herbarium collections. The model (here coined *Collections Records Assessment Model* or *CRAM*) compares the documented species richness value for counties within a state (determined from a database of herbarium records) to the predicted species richness value (determined by the species area relationship formula). Results generated isolate a county by determining if its documented species richness value falls above or below predicted species richness. A county with documented species richness below the predicted value is considered under collected and constitutes a data gap in the state's records. Using *CRAM*, Williams and Lutterschmidt (2006) analyzed Texas and demonstrated that for much of the state's counties (88%) documented species richness values fell below predicted values. Given that documented species richness is a direct function of collections (Preston 1948; Williams & Lutterschmidt 2006), counties with species richness values below predicted richness are counties with little or no specimen collecting thus representing data-gaps in the state's herbaria.

A state requires two data sources to perform *CRAM*. The first data source is a database or Atlas of a substantial (if not entire) portion of a state's herbarium specimens. The database should be constructed in such a way that the number of species documented per county can be reported. Data source two requires that a state have a substantial number (15+) of published floristic inventories that represent a varying array of area size (from State level down to a few hectares). Information needed from each published inventory is the area of the study site and the number of species reported from that area. These values are necessary for determining the constants C and z used in the species area relationship formula $S=CA^z$. Species-area relationship is regarded as "one of community ecology's few laws (Schoener 1976)." The species-area relationship simply states that as area increases species richness increases (Brown & Lomolino 1998). The species area relationship can therefore be used to estimate or predict the number of species within a given area. In the formula S = species richness, A = Area, C = the number of species when area equals 1, this is defined by the intercept of the slope for known values (those gathered from the floristic inventories) and z = the rate of increase in species as area increases, this is defined by the slope of the known values (those gathered from the floristic inventories; MacArthur & Wilson 1967). After surveying the literature and state herbaria it was determined that Florida possessed substantial data in both sources. Consequently, we present an analysis of the documented floristic completeness for the state of Florida.

METHODS AND MATERIALS

Published checklists and floras for regions with defined boundaries within the state of Florida were identified (Table 1) using the FloraS of North America project (Qian et al. 2007). From each checklist the number of species was recorded and the geographic flora-coverage area (kilometers^2) was calculated. Both metrics were log transformed and entered into a database. The database was imported into SPSS 10.1 and linear regression was used to determine the relationship between species richness (dependent variable) and area (independent variable). From this analysis both the slope (z value) and the intercept (C value) for vascular plants in Florida were determined (Fig. 1).

To determine predicted species richness for each individual county in Florida the C and z constants were then applied to the Arrhenius log-log ($\log S = \log C + \log A^z$) model with A representing the area in square kilometers for each of the 67 counties (Table 2) in Florida.

We then accessed the Atlas of Florida Vascular Plants (Wunderlin & Hansen 2008) database and recorded the taxa richness reported from each county in Florida. Note that we reported here taxa richness rather than species richness. This is because: 1) Wunderlin and Hansen (2008) were thorough in their documentation of both species and their intra-specific taxa (both sub-species and varieties) and 2) it is the actual number of biological entities that we are concerned with rather than their systematic position. Whether a taxon is recognized as a species or a variety does not diminish the fact that it ecologically unique from other taxa and occupies space within the designated area under study.

RESULTS AND DISCUSSION

The constants z (0.17) and C (245) for vascular plants in Florida were determined using linear regression (Fig. 1) of geographical area and documented species richness values gathered from the 27 representative floristic inventories in Florida (Table 1). The determined value of z is within the accepted range of z values (0.12–0.17) for vascular plants within continents (MacArthur & Wilson 1967). The rather high z for Florida, in comparison to the entire range for terrestrial plants, is readily explained by the tropical physiognomy of the state. C indicates a species richness of 245 species for any given square-kilometer area in Florida. Using the obtained C and z values, we then predicted species richness for each of the 67 counties in Florida (Table 2).

A cubic regression analysis was used to compare documented ($r^2 = 0.165$) and predicted species richness ($r^2 = 0.999$) for each of the 67 counties in Florida (Fig. 2). Counties with documented species richness that approximate (here determined as within 95% of predicted richness) or exceed predicted species richness fall near, on or above the predicted regression line; counties that have an under representation of species richness fall well below the predicted regression line (Fig. 2). This cubic regression model allows curators and researchers to identify counties that are under collected/documented. Our results indicate that 22 (or 32.8%) of the 67 counties in Florida fall well below the predicted line and are, therefore, considered under collected counties (Table 2 and Fig. 3). The total area (38240 km^2) occupied by these under collected counties covers 26.5 % of Florida. Compared to the state of Texas, with only 29 out of the 254 counties well collected, the state of Florida is very strong in the documentation of vascular plant richness. It is suggested however, that effort be made to improve the collection and documentation of species richness for the under collected counties in Florida, specifically Baker, Glades, Hendry, Lafayette, Okeechobee, and Union Cos. (Table 2) which have documented less than 70% of the predicted species for their county.

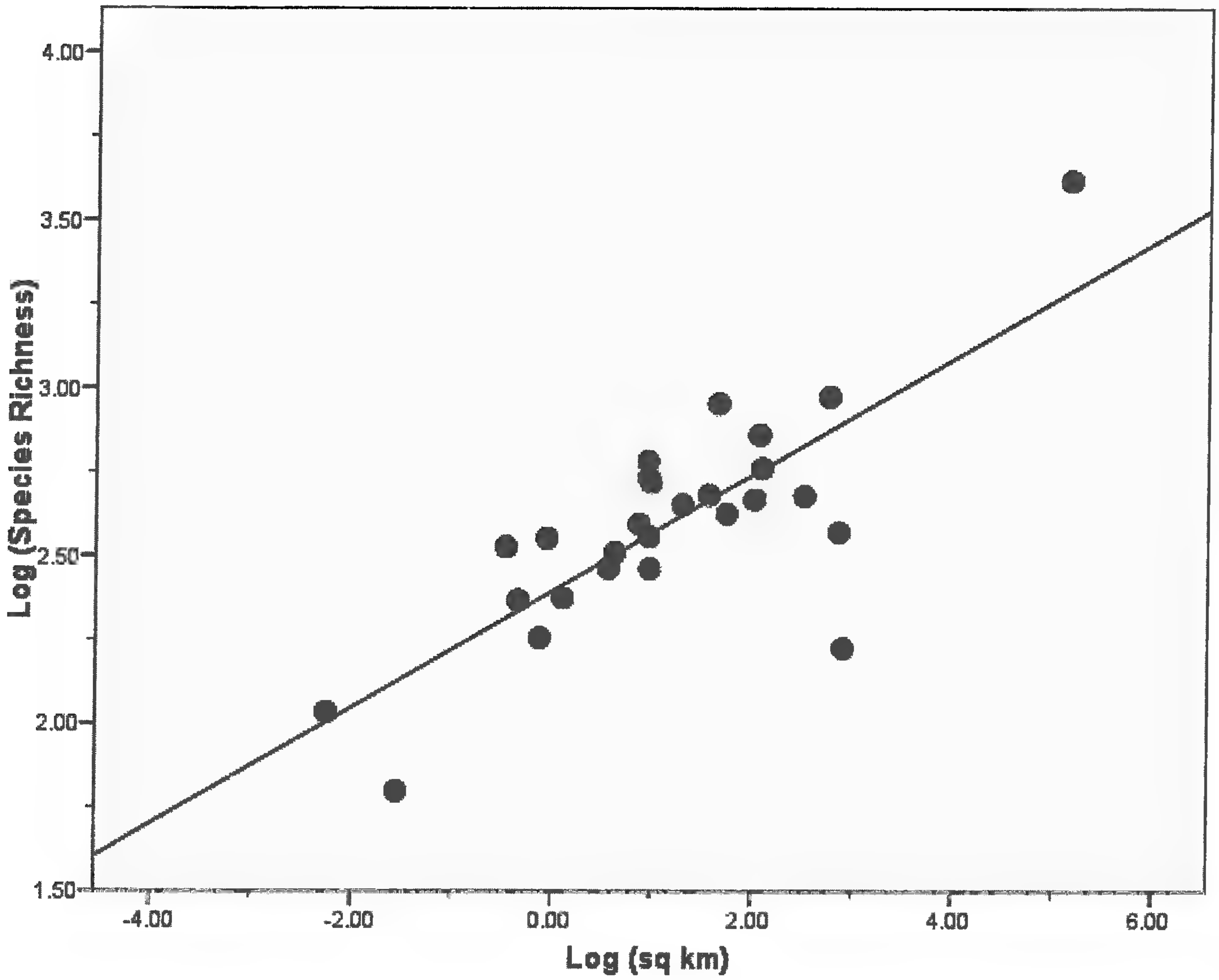

Fig. 1. Logarithmic relationship between species richness and geographic area. Dots = each of the 27 checklist and floras listed in Table 1 plotted for documented species richness and geographical area. Solid line = the regression between documented species richness and geographical area. The regression indicates a significant relationship between species richness and geographical area ($F = 39.737$, $df = 25$, $r^2 = 0.614$). Constants *C* and *z* were obtained from this analysis and used in the species-area relationship formula $S = CA^z$.

It is recognized that additional checklist for Florida probably exist, most likely in the form of unpublished government reports, and that those used (Table 1) for this study are only published representatives of the potential literature for Florida. Regardless, we feel that those used in this study represent well the degree of variation needed to determine credible *C* and *z* values. In particular the floras used represent an astonishing array of area size, ranging from the entire state with 144557 km^2 to a mere 0.01 km^2. In addition, when *C* is calculated using only 14 of the floras (selecting every other flora when arranged from largest to smallest starting with the entire state) the *C* value is 253, only an eight species difference from the 245 used for this analysis. Indeed, eight species can make a substantial difference when factoring in an increase in area, however when using predicted species richness values generated from a *C* value of 253 to determine the completeness of the Florida plant record, there is no substantial difference in the counties isolated as when using a *C* value of 245. We do accept that over time, and with it the consequent accumulation of additional data, the values presented in this study (Table 2) may and probably will change. We stress, however, that it is not our aim to present fixed species richness values per county, but rather to provide benchmark values that can be used in focusing collection/documentation effort.

Williams and Luttershmidt (2006) demonstrated that in Texas documented species richness values were in general greater in counties that had herbaria and lower in counties without herbaria. The implication is

Table 1. Published values of species richness for vascular plants and associated geographic area.

Number of Species	Area (km2)	Generalized Location	Citation
4144	144557.60	Florida State	Wunderlin & Hansen 2008
943	582.75	Merrit Island, Brevard Co.	Poppleton et al. 1977
899	46.54	Jonathan Dickinson State Park, Martin Co.	Roberts et al. 2006
726	116.81	Myakka River State Park, Sarasota and Manatee Cos.	Huffman & Judd 1998
604	9.06	Ichetucknee Springs, Suwannee and Colombia Cos.	Herring & Judd 1996
576	124.84	Waccasassa Bay, Levy Co.	Abbott & Judd 2000
540	9.25	O'Leno State Park and northeast River Rise State Preserve Alachua and Columbia Cos.	Tan & Judd 1995
523	9.79	Little Manatee, Hillsborough Co.	Myers & Wunderlin 2003
480	37.24	Timucuan ecological and historic preserve, Duval Co.	Zomlefer et al. 2007
477	326.34	Fakahatchee Strand State Preserve, Collier Co.	Austin et al. 1990
466	105.15	Bull Creek, Osceola Co.	Huck 1979
449	20.20	Cedar Key, Levy Co.	Amoroso & Judd 1995
422	56.20	Paynes Prairie, Alachua Co.	Easley & Judd 1990
393	7.43	Dog Island, Franklin Co.	Anderson & Alexander 1985
372	730.38	Biscayne National Park, Miami-Dade Co.	Stalter et al. 1999
360	9.32	Manatee Springs, Levy Co.	Gulledge & Judd 2002
356	0.88	Gold Head Branch Ravine and Adjacent Uplands, Clay Co.	White & Judd 1985
336	0.34	The Hammock, Dunedin, Pinellas Co.	Genelle & Fleming 1978
323	4.22	Gulf Islands National Seashore, Perdido Key, Escambia Co.	Looney et al. 1993
290	3.65	Fort DeSoto Park, Pinellas Co.	Thorne 1995
289	9.51	Little Talbot Island, Duval Co.	Easley & Judd 1993
237	1.27	Fort Matanzas National Monument, St. Johns Co.	Zomlefer et al. 2004
233	0.46	Blowing Rocks Preserve, Martin Co.	Richardson et al. 1992
180	0.75	Atlantic University Ecological Site, Broward Co.	Austin 1990
168	810.67	Ocala National Forest, Marion Co.	Mohlenbrock 1976
108	0.01	Turtle Mound, Volusia Co.	Norman 1976
63	0.03	Chicken Key, Miami-Dade Co.	Guala 1993

that botanists tend to concentrate their specimen collections in localities near their work or home base. The phenomena of collecting near biological stations was termed the "Collector's Syndrome" by Soberon et al. (1996) and later "The Botanist Effect" by Moerman and Estabrook (2006). Indeed, within Florida the counties with lower than expected species richness values are ones without herbaria (Fig. 3). It is acknowledged, however, that there are plenty of counties without herbaria that have documented species richness greater than predicted values (Fig. 3). Pautasso et al. (2007) suggest that species richness values are higher in some counties not because of the efforts of botanical collecting, but rather because humans tend to concentrate in areas with higher bio-diversity (more plant species = more humans = more botanist = herbaria). They demonstrated a positive correlation for all the counties in the Continental United States, showing that Human population increased with an increase in plant species richness. The question of whether botanist drive documented species richness or species richness drives human settlement is a "Chicken and Egg" argument that is better argued elsewhere. However based on our research we do believe that documented species richness is a product driven by the efforts of botanist and not vice versa.

This paper is one of many in the recent effort to develop models that predict species richness values for the vascular flora of the United States. The methods use a variety of techniques including GIS modeling (Iverson & Prasad 1998; Jarnevich et al. 2006) and species area relationship (SAR) (McNeill & Cody 1978; Buys et al. 1994; Williams & Lutterschmidt 2006; Qian et al. 2007). The aim in developing such models is to provide benchmark SR values that can be used for a variety of conservation efforts including assessing the completeness of museum collections (Williams & Lutterschmidt 2006; demonstrated here), determining

TABLE 2. List of the 67 counties in Florida, their documented taxa richness (generated from Wunderlin and Hansen 2008), predicted richness (generated from the formula $S=CA^z$), area and whether or not documented taxa richness exceeded predicted species richness. *= Counties with true documented values less than predicted values but falling within 95% error.

County	**Documented taxa richness**	**Predicted species richness**	**Area (km. mi.)**	**Documented taxa greater than predicted richness?**
Alachua	1547	943	2264	TRUE
Baker	583	880	1516	FALSE
Bay	998	921	1978	TRUE
Bradford	528	780	759	FALSE
Brevard	1174	968	2637	TRUE
Broward	1039	997	3122	TRUE
Calhoun	1070	875	1469	TRUE
Charlotte	772	906	1796	FALSE
Citrus	1137	879	1512	TRUE
Clay	985	884	1557	TRUE
Collier	1247	1090	5246	TRUE
Columbia	947	928	2064	TRUE
DeSoto	670	893	1651	FALSE
Dixie	735	908	1823	FALSE
Duval	1231	923	2004	TRUE
Escambia	1586	899	1715	TRUE
Flagler	777	851	1256	FALSE
Franklin	1531	869	1410	TRUE
Gadsden	1238	861	1337	TRUE
Gilchrist	609	804	904	FALSE
Glades	490	923	2004	FALSE
Gulf	761	871	1436	FALSE
Hamilton	579	860	1333	FALSE
Hardee	664	893	1651	FALSE
Hendry	527	989	2985	FALSE
Hernando	1218	849	1239	TRUE
Highlands	1095	970	2663	TRUE
Hillsborough	1608	973	2722	TRUE
Holmes	602	851	1250	FALSE
Indian River	742	857	1303	FALSE
Jackson	1460	950	2372	TRUE
Jefferson	935	883	1548	TRUE
Lafayette	444	868	1406	FALSE
Lake	1232	957	2469	TRUE
Lee	1275	929	2081	TRUE
Leon	1686	900	1727	TRUE
Levy	1236	984	2897	TRUE
Liberty	1345	935	2165	TRUE
Madison	642	905	1792	FALSE
Manatee	1120	916	1919	TRUE
Marion	1248	1044	4089	TRUE
Martin	995	872	1439	TRUE
Miami-Dade	1676	1083	5040	TRUE
Monroe	1135	964	2582	TRUE
Nassau	929	896	1688	TRUE
Okaloosa	1201	954	2423	TRUE
Okeechobee	563	923	2005	FALSE
Orange	1100	949	2350	TRUE
Osceola	837	1013	3424	FALSE
Palm Beach	1042	1085	5113	TRUE*

Table 2. continued

County	Documented taxa richness	Predicted species richness	Area (km. mi.)	Documented taxa greater than predicted richness?
Pasco	1117	917	1929	TRUE
Pinellas	1173	774	725	TRUE
Polk	1294	1076	4855	TRUE
Putnam	1029	912	1870	TRUE
Santa Rosa	1270	968	2634	TRUE
Sarasota	995	876	1480	TRUE
Seminole	887	787	798	TRUE
St. Johns	857	886	1577	TRUE*
St. Lucie	686	876	1483	FALSE
Sumter	925	869	1413	TRUE
Suwannee	606	904	1781	FALSE
Taylor	805	972	2699	FALSE
Union	458	754	622	FALSE
Volusia	1311	981	2857	TRUE
Wakulla	1262	885	1571	TRUE
Walton	1315	974	2739	TRUE
Washington	837	878	1502	TRUE*

the degree of invasiveness (Jarnevich et al. 2006), and determining the degree of sampling effort needed to complete a survey (Palmer et al. 2002). We believe that such models are important in directing future collecting, research and granting efforts, as well as laying the foundation for testing theoretical models.

ACKNOWLEDGMENTS

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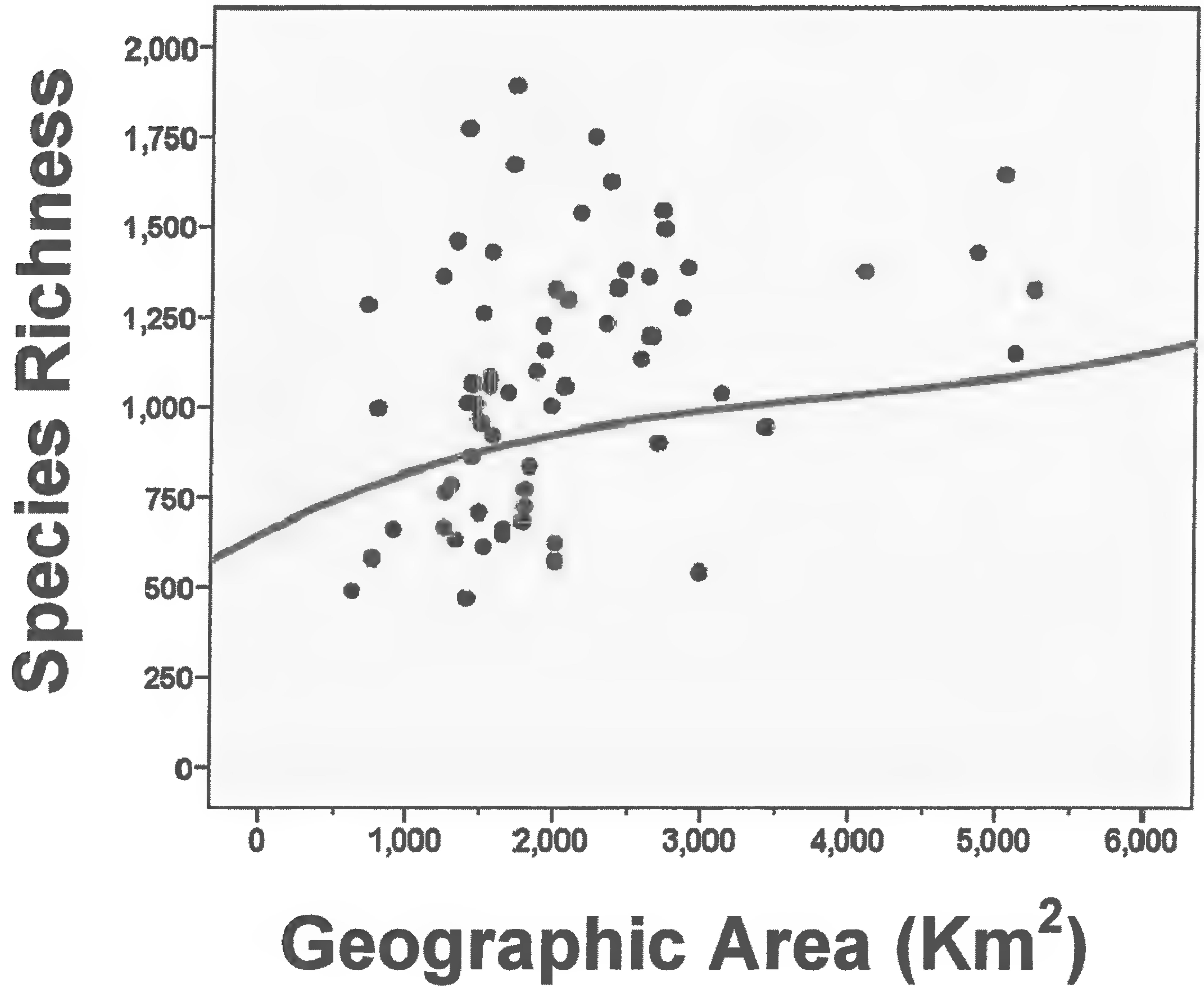

Fig. 2. Relationship between species richness and geographic area. Dots = each of the 67 counties in Florida plotted for documented taxa richness (y axis) and geographical area (x axis). Solid line = the cubic regression between predicted species richness and geographical area. Counties (dots) on or above the predicted species richness (line) indicate well collected counties that match or exceed predicted species richness.

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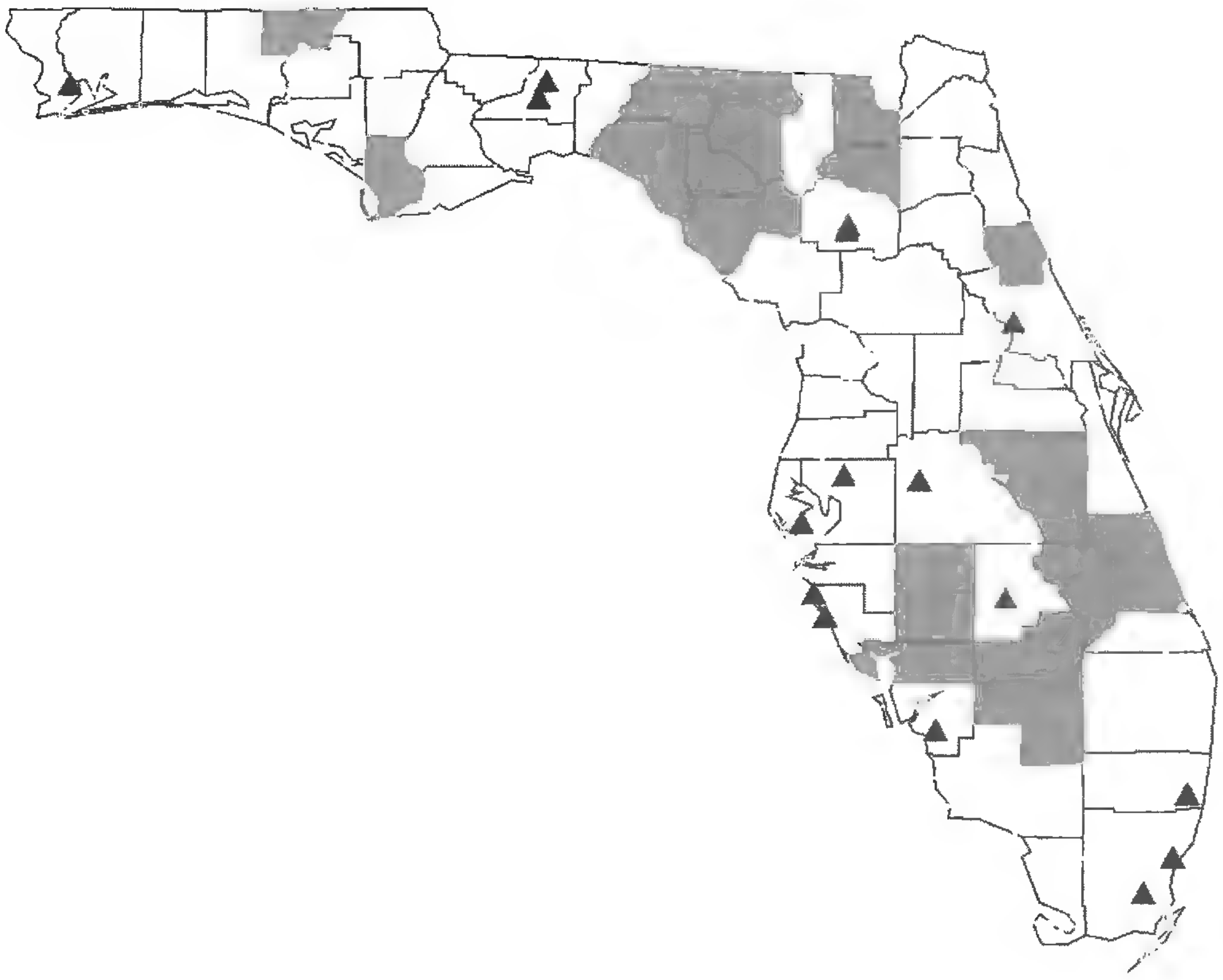

Fig. 3. Counties (shaded) where documented species richness is lower than predicted species richness. For the majority of counties in Florida documented species richness matches or exceeds predicted richness. Triangles represent the location of herbaria. FTU in Orange Co. was not included in this map as it is chiefly a Bryophyte collection.

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BOOK REVIEW

David Cutler, Ted Botha, and Dennis Stevenson. 2008. **The Virtual Plant (Network CD-ROM).** (ISBN 978-1405169707, hbk.). Wiley-Blackwell Publishing, 2121 State Avenue, Ames, Iowa 50014-8300, U.S.A. (**Orders:** www.blackwellpublishing.com, orders@ames.blackwellpublishing.com, 800-862-6657). $300.00.

Conceptualizing the structure of a plant can become very abstract when we start talking about small arrangements, like the stem diaphragm that improves flotation in aquatic plants. *The Virtual Plant* CD-ROM is a good source of visual support that makes this approach more concrete. Users will find a variety of images to help them visualize all the information that is presented as written text in the companion book *Plant Anatomy: An Applied Approach.* When used in a laboratory setting, one would imagine the entire lab experience to be more enriching for both teacher and student, using these digital visual aids as guideposts while navigating manual, real-world microscopy. Also included on the CD are a number of useful presentations that can be used and adapted for teaching purposes and more.—*Natalia Quinteros, Graduate Student, Texas Christian University and Botanical Research Institute of Texas, Fort Worth, Texas, U.S.A*

From the Back Cover: "*The Virtual Plant* CD-ROM is a companion to the book *Plant Anatomy*, an essential reference for undergraduates taking courses in plant anatomy, applied plant anatomy and plant biology, and for researchers and postgraduates in plant sciences.

This Network version of the CD-ROM contains high-quality photographs and scanning electron microscope images. This key resource will give students access to the microscopic detail of plant structures, essential to gaining a real understanding of the subject. Exercises for the laboratory are also included on the CD-ROM, making this work an indispensable resource for lectures and laboratory classes."

J. Bot. Res. Inst. Texas 2(2): 1372. 2008

SPECIES RICHNESS OF VEGETATIONAL AREAS OF TEXAS: A FIRST APPROXIMATION

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ABSTRACT

Using the *Atlas of the Vascular Plants of Texas* and the generally accepted vegetational area map of Texas, we analyzed the species richness of the different areas of Texas. We found that the vegetational areas are not equally rich and that richness does not correlate with primary productivity or size of area. Interestingly, the ratio of monocots to dicots is not the same in the eastern and western parts of the state. Other patterns also are apparent: Poaceae dominate the monocots in the west but not in the east; Cyperaceae are much more common in the east than in the west; Cactaceae are much more common in the west than in the east; Asteraceae and Fabaceae are about equal in both regions. We suggest that the traditional vegetational areas of Texas probably should be reassessed and perhaps a simpler vegetational map devised that is more congruent with current distributional information.

RESUMEN

Usando el *Atlas of the Vascular Plants of Texas* y el mapa generalmente aceptado de áreas de vegetación de Texas, se ha analizado la riqueza en especies de las diferentes áreas de Texas. Encontramos que las áreas de vegetación no son igual de ricas y que la riqueza no se correlaciona con la producción primaria o el tamaño del área. Es interesante que la relación de monocotiledóneas a dicotiledóneas no es la misma en las partes este y oeste del estado. Otros patrones son también aparentes: Las Poaceae dominan las monocotiledóneas en el oeste pero no en el este; las Cyperaceae son mucho más comunes en el este que en el oeste; las Cactaceae son mucho más comunes en el oeste que en el este; Las Asteraceae y Fabaceae son casi iguales en ambas regiones. Se sugiere que las áreas de vegetación tradicionales de Texas probablemente deberían reestudiarse y quizás elaborar un mapa de vegetación más simple que sea más congruente con la actual información sobre la distribución.

INTRODUCTION

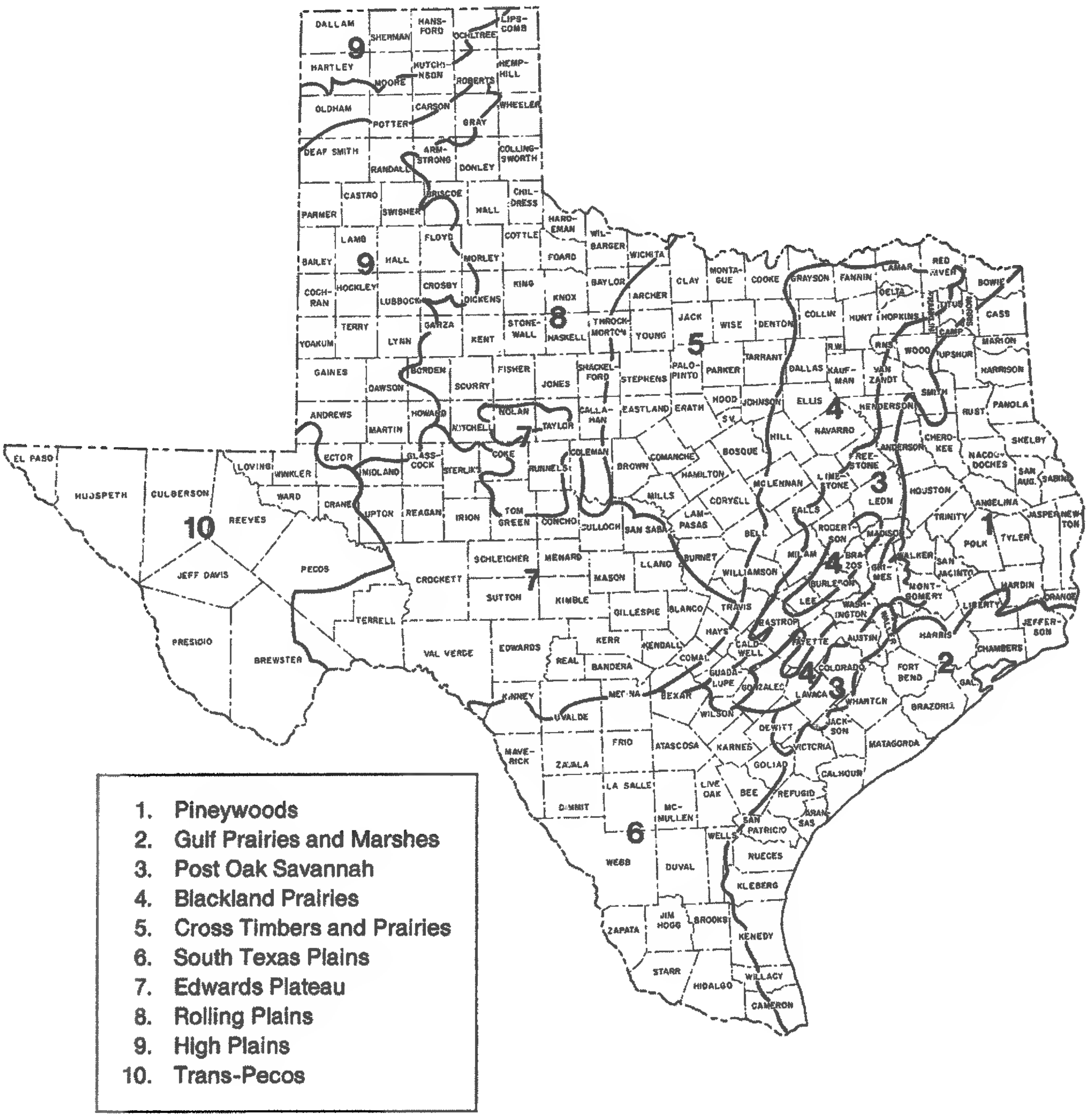
It is well known that the different vegetational areas of Texas (sometimes called vegetational regions) are not equally rich in species. For example, Diggs et al. (2006) have indicated that, while east Texas has 3402 taxa, north central Texas has only 2376 taxa and that the Great Plains, although one-fifth the land mass of the United States, has only 3067 taxa. The latitudinal gradient in species richness is well known and is as true of plants as it is of animals, but little is understood about the factors determining species richness (Owen 1990; Thorne 1993; Ziv & Tsairi 2004; MacRoberts et al. 2007; Qian et al. 2007).

The Turner et al. (2003) *Atlas of the Vascular Plants of Texas* is primarily useful as a source of distributional information for individual species. However, it (and to a certain extent the Hatch et al. 1990 *Checklist of the Vascular Plants of Texas*) can be used, with caution, as data for other types of studies. In this paper, we use Turner et al. (2003) to determine the species richness of vegetational areas across Texas.

METHODS AND LIMITATIONS

The most often used vegetational areas map of Texas is shown in Figure 1 (Gould 1962, 1975; Correll & Johnston 1970; Jordan et al. 1984; Hatch et al. 1990; Telfair 1999; Turner et al. 2003; Diggs et al. 2006). Using the Turner et al. (2003) *Atlas*, we counted all species that occurred in each vegetational area. This was accomplished by drawing each area on a clear plastic sheet of transparency film the same size as the maps in the *Atlas* and overlaying the transparency on each of the approximately 5030 maps. If the species (dot) occurred within the vegetational area, it was counted as occurring in that area whether or not it was predominately found in another area. We did not question the validity of the traditional vegetational areas nor did we question the dots on the distribution maps in the *Atlas* but accepted them, recognizing that

J. Bot. Res. Inst. Texas 2(2): 1373 – 1379. 2008


1. Pineywoods
2. Gulf Prairies and Marshes
3. Post Oak Savannah
4. Blackland Prairies
5. Cross Timbers and Prairies
6. South Texas Plains
7. Edwards Plateau
8. Rolling Plains
9. High Plains
10. Trans-Pecos
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5
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4
4
4
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3
3
2
2
1
1
10
DALLAM
SHERMAN
HANS-FORD
OCHILTREE
LIPS-COMB
HARTLEY
MOORE
HUTCHI-NSON
ROBERTS
HEMP-HILL
OLDHAM
POTTER
CARSON
GRAY
WHEELER
DEAF SMITH
RANDALL
ARM-STRONG
DONLEY
COLLING-SWORTH
PARMER
CASTRO
SWISHER
BRISCOE
HALL
CHIL-DRESS
BAILEY
LAMB
HALE
FLOYD
MOTLEY
COTTLE
HARD-EMAN
WIL-BARGER
WICHITA
COCH-RAN
HOCKLEY
LUBBOCK
CROSBY
DICKENS
KING
KNOX
BAYLOR
ARCHER
CLAY
MONTA-GUE
COOKE
GRAYSON
FANNIN
LAMAR
RED RIVER
BOWIE
FOARD
YOAKUM
TERRY
LYNN
GARZA
KENT
STONE-WALL
HASKELL
THROCK-MORTON
YOUNG
JACK
WISE
DENTON
COLLIN
HUNT
HOPKINS
DELTA
TITUS
MORRIS
CASS
CAMP
MARION
GAINES
DAWSON
BORDEN
SCURRY
FISHER
JONES
SHACKEL-FORD
STEPHENS
PALO-PINTO
PARKER
TARRANT
DALLAS
KAUF-MAN
VAN ZANDT
R.W.
RAINS
WOOD
UPSHUR
HARRISON
SMITH
GREGG
ANDREWS
MARTIN
HOWARD
MITCHELL
NOLAN
TAYLOR
CALLA-HAN
EASTLAND
ERATH
HOOD
SV.
JOHNSON
ELLIS
HENDERSON
RUSK
PANOLA
NAVARRO
EL PASO
LOVING
WINKLER
ECTOR
MIDLAND
GLASS-COCK
STERLING
COKE
RUNNELS
COLEMAN
BROWN
COMANCHE
HAMILTON
BOSQUE
HILL
FREE-STONE
ANDERSON
CHERO-KEE
NACOG-DOCHES
SHELBY
SAN AUG.
SABINE
HUDSPETH
CULBERSON
WARD
CRANE
UPTON
REAGAN
IRION
TOM GREEN
CONCHO
McCULLOCH
SAN SABA
MILLS
LAM-PASAS
CORYELL
McLENNAN
LIME-STONE
LEON
HOUSTON
ANGELINA
JASPER
NEWTON
REEVES
FALLS
BELL
ROBERT-SON
MADISON
TRINITY
POLK
TYLER
PECOS
JEFF DAVIS
CROCKETT
SCHLEICHER
MENARD
MASON
LLANO
BURNET
MILAM
WILLIAMSON
BRA-ZOS
GRI-MES
WALKER
SAN JACINTO
MONT-GOMERY
HARDIN
ORANGE
SUTTON
KIMBLE
GILLESPIE
BLANCO
TRAVIS
BURLESON
LEE
WASH-INGTON
LIBERTY
JEFFER-SON
TERRELL
PRESIDIO
BREWSTER
VAL VERDE
EDWARDS
KERR
KENDALL
HAYS
BASTROP
WALLER
AUSTIN
HARRIS
CHAMBERS
REAL
BANDERA
COMAL
CALD-WELL
FAYETTE
GUADA-LUPE
GONZALES
COLORADO
FORT BEND
GAL.
KINNEY
UVALDE
MEDINA
BEXAR
LAVACA
WHARTON
BRAZORIA
WILSON
DEWITT
JACK-SON
MATAGORDA
MAVE-RICK
ZAVALA
FRIO
ATASCOSA
KARNES
VICTORIA
GOLIAD
CALHOUN
DIMMIT
LA SALLE
MC-MULLEN
LIVE OAK
BEE
REFUGIO
ARAN-SAS
SAN PATRICIO
WEBB
DUVAL
JIM WELLS
NUECES
KLEBERG
ZAPATA
JIM HOGG
BROOKS
KENEDY
STARR
HIDALGO
WILLACY
CAMERON

Fig. 1. Vegetational areas of Texas (from Hatch et al. 1990).

the distribution maps are incomplete and there are undoubtedly mistakes in them, and that the traditional vegetational areas are not universally accepted (MacRoberts & MacRoberts 2003a). We did not exclude non-native species but assumed, probably incorrectly, that they would be about equally frequent in each area; also recognizing that non-natives are part of the flora and are here to stay. We included data only at the species level. There are many sources of error in the data from uneven collecting (areas most heavily collected are near universities with herbaria) to the fact that Turner et al. (2003) "in positioning of dots within counties, if only a single collection was noted … usually placed the dot in the center of the county concerned (except in the Trans Pecos region….)." We, therefore, assigned species to areas conservatively: if a dot occurred on the vegetational area boundary we either checked with other sources (e.g., Hatch et al. 1990) to see if the problem could be resolved or counted it as occurring only in the areas already represented by the species. That is, we assumed that it was on the side of the county that was in the vegetational area already occupied. Thus, if an east Texas species occurred as far west as Travis County, and there was a single dot in the center of Travis County where the Edwards Plateau and the Blackland Prairies meet, then the species was not counted as occurring in the Edwards Plateau vegetational area but only in the area or areas to the east. We did not encounter many of these border problems, but to have an independent assessment of the accuracy of the Turner et al. (2003) maps, we compared them with the reported distribution of species in Hatch et al. (1990) where there is no ambiguity in vegetational area reported. For this comparison, we used the Pteridophytes and Gymnosperms in one sample and the Cyperaceae in another. We found a very strong positive correlation between the Turner et al. (2003) and Hatch et al. (1990) samples ($R^2 = 0.8648$ and $R^2 = 0.8023$, respectively), supporting our use of the Turner et al. (2003) data as satisfactory for the task at hand. In addition, the sample taken from the Turner *Atlas* is over 5000 species and ten vegetational areas, which is a substantial amount of data. We, therefore, do not believe that the problem of "dot placement" introduces a great deal of error as compared to other problems, such as uneven collecting among the different vegetational areas.

We looked at the distribution of several plant families (Poaceae, Cyperaceae, Asteraceae, Cactaceae, and Fabaceae) by vegetational area to see if any patterns of plant distribution were evident.

We used Owen and Schmidly's (1986) above-ground primary productivity (primary productivity index) data for Texas to see if this correlated with species richness. We averaged their data for each vegetational area to obtain a single figure for comparison with our richness numbers.

RESULTS AND DISCUSSION

The species area/vegetational area results are summarized in Table 1. Texas vegetational areas are not equally species rich. The Gulf Prairies and Marshes are the richest, the Trans-Pecos is second, and the Pineywoods is third. The High Plains are the least rich.

Species richness correlates only very weakly and negatively ($r_s = -0.3697$) with size of vegetational area. The Edwards Plateau ranked first in size but fourth in richness; the Rolling Plains ranked second in size but ninth in richness, and so on.

Species richness correlates only very weakly but positively ($r_s = 0.3455$) with primary productivity. Gulf Prairies and Marshes rank first in species richness but third in productivity. Trans-Pecos ranks second in species richness but tenth in productivity, and so on. These findings agree in general with those of Owen (1990), who found for mammals evidence contradictory to the hypothesis that greater productivity is associated with greater species richness. Samples at other scales than those used by Owen or ourselves might show different results, but this was not tested.

Breaking down the major figures somewhat, the monocot/dicot/Gymnosperm-Pteridophyte ratios fell into two groups across Texas. For the eastern parts of Texas, monocots varied between 29% and 30%, dicots between 67% and 69%, and Gymnosperms and Pteridophytes between 2% and 3%. For the western part of Texas, monocots varied between 19% and 24%, dicots between 74% and 77%, and Gymnosperms and Pteridophytes between 2% and 4%. There is a significant difference (chi square = 116, 3df, p = .00001) between these groups. Interesting here is that the number of grass species by vegetational area appears to be practically the same ranging from 11.2% for the Pineywoods to 16.6% for High Plains, with the others grouped closely between these (Table 2). However, when monocots alone are considered, grasses dominate the west Texas vegetational areas but do not dominate the east Texas vegetational areas. In the four easternmost areas of Texas, grasses constitute less than 50% (range 36.9% to 47.8%) of the monocot flora, but in the six westernmost areas, they constitute more than 50% (range 52.8% to 68.5%). Cyperaceae show the opposite trend (Table 3) and are much more common in the east than in the west. Asteraceae show only a mild trend toward being more common in west Texas than in east Texas (Table 4). Fabaceae show virtually no east-west trend (Table 5), but Cactaceae show a clear east-west trend (Table 6).

The reason for the differences in species richness among areas is not easily understood (Owen 1990; Withers et al. 1998; Qian et al. 2007; see also discussion in Diggs et al. 2006; MacRoberts & MacRoberts 2008 in press), but presumably a combination of complicated interrelated factors (elevation variation, precipitation and its seasonality, soil diversity, temperature extremes and averages, sunshine, geological

Table 1. Number and percentage of pteridophytes, gymnosperms, monocots, dicots, total species, area in millions of ha., and productivity of Texas vegetation areas. Area data from Hatch et al. (1990). Primary productivity index from Owen and Schmidly (1986).

Vegetation region	Ptero. & Gymno.	Monocots	Dicots	Total	Area	Productivity
Gulf Prairies & Marshes	43 (2%)	667 (29%)	1607 (69%)	2317	4.1	1905
Trans-Pecos	95 (4%)	411 (19%)	1688 (77%)	2194	7.3	295
Pineywoods	58 (3%)	655 (30%)	1440 (67%)	2153	6.4	2161
Edwards Plateau	70 (3%)	482 (23%)	1535 (74%)	2087	10.3	906
Blackland Prairie	41 (2%)	582 (29%)	1391 (69%)	2014	5.1	1848
Post Oak Savanna	38 (2%)	567 (30%)	1258 (68%)	1863	2.8	1981
Cross Timbers	38 (2%)	420 (24%)	1271 (74%)	1729	6.2	1397
South Texas Plains	28 (2%)	353 (23%)	1169 (75%)	1550	8.5	948
Rolling Plains	19 (2%)	284 (24%)	902 (75%)	1205	9.7	794
High Plains	19 (2%)	216 (24%)	658 (74%)	893	7.9	529

Table 2. Number and percentage of Poaceae by vegetational area.

Vegetational Area	Number of species	Percentage of total species in area	Percentage of monocots only
Pineywoods	242	11.2	36.9
Gulf Prairies & Marshes	319	13.8	47.8
Blackland Prairies	277	13.8	47.6
Post Oak Savannah	246	13.2	43.3
Edwards Plateau	263	12.6	54.6
Cross Timbers	222	12.8	52.8
South Texas Plains	224	14.5	63.4
Trans-Pecos	254	11.6	61.8
Rolling Plains	168	13.9	59.2
High Plains	148	16.6	68.5

Table 3. Number and percentage of Cyperaceae by vegetational area.

Vegetational Area	Number of species	Percentage of total species in area	Percentage of monocots only
Pineywoods	205	9.5	31.3
Gulf Prairies & Marshes	168	7.3	25.2
Blackland Prairies	164	8.1	28.2
Post Oak Savannah	163	8.7	28.7
Edwards Plateau	93	4.4	19.3
Cross Timbers	90	5.2	21.4
South Texas Plains	58	3.7	16.4
Trans-Pecos	57	2.6	13.9
Rolling Plains	52	4.3	18.3
High Plains	32	3.6	14.8

complexity, etc.) is responsible, none of which is easy to measure. Intuitively, it would seem that areas with relatively high seasonal temperatures and rainfall, e.g., the Pineywoods, would have high species richness. At the same time, the environmentally diverse Trans-Pecos, with its great topographical relief and diverse habitats that range from deserts to wooded mountain slopes, also would support a high number of species. Areas with moderate to low habitat diversity, moderate to low rainfall, and intermediate temperatures might be expected to have fewer species.

Table 4. Number and percentage of Asteraceae by vegetational area.

Vegetational Area	Number of species	Percentage of total species in area	Percentage of dicots only
Pineywoods	248	11.5	17.2
Gulf Prairies & Marshes	265	11.4	16.5
Blackland Prairies	255	12.7	18.3
Post Oak Savannah	226	12.1	18.0
Edwards Plateau	178	13.3	18.1
Cross Timbers	235	13.6	18.4
South Texas Plains	210	13.5	18.0
Trans-Pecos	327	14.9	19.3
Rolling Plains	179	14.8	19.8
High Plains	146	16.3	22.2

Table 5. Number and percentage of Fabaceae by vegetational area.

Vegetational Area	Number of species	Percentage of total species in area	Percentage of dicots only
Pineywoods	162	7.5	11.3
Gulf Prairies & Marshes	167	7.2	10.4
Blackland Prairies	154	7.6	11.1
Post Oak Savannah	149	7.9	11.8
Edwards Plateau	164	7.9	10.7
Cross Timbers	147	8.5	11.5
South Texas Plains	137	8.8	11.7
Trans-Pecos	159	7.2	9.4
Rolling Plains	106	8.7	11.6
High Plains	74	8.2	11.2

Table 6. Number and percentage of Cactaceae by vegetational area.

Vegetational Area	Number of species	Percentage of total species in area	Percentage of dicots only
Pineywoods	5	0.2	0.3
Gulf Prairies & Marshes	17	0.7	1.1
Blackland Prairies	8	0.4	0.6
Post Oak Savannah	7	0.4	0.6
Edwards Plateau	45	2.2	2.9
Cross Timbers	18	1.0	1.4
South Texas Plains	30	2.5	3.3
Trans-Pecos	75	3.4	4.4
Rolling Plains	18	1.5	2.0
High Plains	14	1.6	2.1

In the course of this work we recognized that plant species do not appear to pay much attention to vegetational area boundaries. The vast majority of species are not confined to any one area but spill out into adjacent areas. Thus, the most often used Texas vegetational area map (Figure 1), and its many derivatives and modifications, does not appear to be very accurate; it is probably no more accurate than any of the ecoregional maps so far produced (see MacRoberts & MacRoberts 2003a for a discussion of various vegetational schemes for the West Gulf Coastal Plain). For example, east Texas, although it is almost always mapped as several vegetational areas, has no floristic breaks (MacRoberts & MacRoberts 2003b). The Pineywoods grades into Post Oak Savannah, which in turn grades into Blackland Prairie, and southward into the Coastal Prairies and Marshes. These regions share 98% of their flora (MacRoberts & MacRoberts 2004). Only a few areas in Texas might be true breaks, one such being the southeastern part of the Edwards Plateau where the Balcones Escarpment seems to be a floristic barrier. However, the Edwards Plateau grades northward into the Cross Timbers, Rolling Plains, and High Plains, and westward into the Trans-Pecos. The main floristic break in Texas is right down the middle of the state in a 300 km wide ecotone between about 96° and 99° W longitude (MacRoberts & MacRoberts 2003b, see also McLaughlin 2007). Consequently, we believe that it is time to re-think vegetational area mapping for Texas in light of the extensive collecting that has occurred over the past half-century and to use the total flora as a basis for establishing vegetational areas.

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BOOK REVIEW

RONALDO BARTHEM AND MICHAEL GOULDING. 2007. **An Unexpected Ecosystem: the Amazon as Revealed by Fisheries.** (ISBN 978-9972-2912-4-1, pbk.). Missouri Botanical Garden Press, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A. (**Orders:** www.mbgpress.info, 314-577-9594 fax). $35.00, 241 pp., color photographs and illustrations, 9" × 10 1/2".

From the first chapter of *An Unexpected Ecosystem* you will notice how the book describes in great detail how important the fish are to the rainforest ecosystem and to the rest of the world. Although I feel this book is focused toward the more scientific mind, it is filled much information that will also entertain the reader just looking for a good informational book about fish of the Amazon River.

An Unexpected Ecosystem has over 200 color photographs that really help tell the story over the concern of fisheries on the Amazon River. The book also does a great job at describing both the good fishing methods and, unfortunately for the ecosystem, the bad fishing methods. Being a person who is fascinated with interesting facts, I particularly enjoyed the detailed graphs and charts presented in the book. They too help extenuate the message being told in the text. I do feel the text is hard to follow in a sense of understanding all of the information, but it does a good job at describing so much information for such a short book.

One of my favorite features of the book is the descriptions of the 29 commercial food fishes. Each fish has its own detailed description including its origin with detailed, color coded maps, as well as migratory patterns, spawning periods, and much more. Each individual fish species also has a great photograph along with everything else.

Not only will *An Unexpected Ecosystem* educate you about the fish in the Amazon River, but it will also teach you much about the conservation of the river itself and much of the forest around it. I would highly recommend this book to anybody who is interested in the conservation of the Amazon Rainforest. It is a lot of information that you will enjoy sharing at your dinner table.—*Kyle Rasmussen, Intern, Botanical Research Institute of Texas, 500 East 4th Street, Fort Worth, Texas 76102-4025, U.S.A.*

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CAREX BREVICULMIS (CYPERACEAE), NEW TO THE FLORA OF NORTH AMERICA

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ABSTRACT

Carex breviculmis, a species native to Asia, Australia, and the Indian Subcontinent, was collected early in 2007 in Lauderdale County, Mississippi, U.S.A., at two areas in the city of Meridian. Further work in the area in the spring of 2008 revealed two more locations for this species. It was not known from North America prior to this discovery. Repeated trips to these sites revealed that this species appears to be established, maintaining viable populations from year to year, and could become weedy. We provide a detailed description and illustration of the species as well as a discussion of possible means and the implications of this introduction.

RESUMEN

Carex breviculmis, especie nativa de Asia, Australia, y el subcontinente Indio, fue colectado en el condado Lauderdale en la parte este central del estado de Mississippi, EE. UU. a principios de 2007, en dos localidades diferentes alrededor de la ciudad de Meridian. Trabajo adicional en el área durante la primavera del 2008 reveló dos nuevas localidades para la especie. *Carex breviculmis* no era conocida de la flora de Norte América antes de este descubrimiento. Varios viajes a estos sitios revelaron que la especie parece estar bien establecida, manteniendo poblaciones viables de año en año, pudiéndose convertir en una maleza. Discutimos los posibles medios y las implicaciones de su introducción. Además se presenta una descripción e ilustración detallada de la especie.

INTRODUCTION

Carex breviculmis R. Br., Ao-suge or blue sedge, was described from Australia in 1810 (Moore & Edgar 1976; Walker 1976). It is a widespread species native to the far-east and is known from east Afganistan, Australia, China, India, Japan, Korea, Malaysia, Nepal, New Guinea, New Zealand, Pakistan, Russia, and Taiwan (Hooker 1894; Goncharov et al. 1964; Ohwi 1965; Moore & Edgar 1976; Walker 1976; Koyama 1978; Egorova 1999; Kukkonen 2001). This species is a perennial that inhabits "open fields" and "sandy coasts" (Ohwi 1965), "exposed grassy slopes and water courses" (Goncharov et al. 1964), "open grasslands, forest margins" and other disturbed areas (Walker 1976; Koyama 1978), and mountainous areas with altitudes ranging from 2000–3900 m (Hooker 1894; Kern 1976; Kukkonen 2001). *Carex breviculmis* forms a complex, which can be found from "NW Himalaya to Japan and through Malaysia to Tasmania and New Zealand" (Kukkonen 2001).

Carex breviculmis is highly variable (Walker 1976; Koyama 1978). A number of species have been described within this complex that are now considered conspecific with *C. breviculmis*, e.g., *C. leucochlora* Bunge, *C. royleana* Nees (Ohwi 1965; Koyama 1978) or as distinct species (Egorova 1999; Kukkonen 2001). Additionally, numerous subspecies and varieties have been recognized in order to describe this variation (Ohwi 1965; Merrill 1968; Walker 1976; Koyama 1978). Egorova (1999) treats *C. breviculmis* and *C. leucochlora* as distinct species and separates them based on culm height, with *C. breviculmis* having culms from 1–2 cm in height and many, distinct veins on the perigynia. Egorova (1999) also states that the type specimens of *C. royleana* and *C. hypochlora* Freyn, are "identical" to *C. leucochlora*. Kukkonen (2001) places *C. brevilculmis* ssp. *royleana* in synonymy under *C. royleana*, but mentions that the *C. breviculmis* complex, which includes *C. leucochlora*, needs revision. Obviously, there is a great deal of confusion about taxonomic circumscription within this group. Based on inspection of specimens of *C. breviculmis* and *C. leucochlora* at MO and based on the morphology of our specimens and current nomenclature in Tropicos (2008), we determined that our collections most closely correspond with *C. breviculmis*.

SPECIES DESCRIPTION

Carex breviculmis belongs to the species rich Old World section *Mitratae* and can immediately be distinguished from all other species in North America except *Carex caryophyllea* Latourrette by the tubercle-like structure at the achene apex. Prior to our discovery, the only species of *Carex* within this section known to U.S.A. was *C. caryophyllea*. *Carex caryophyllea*, an introduction from Europe, was discovered in Massachusetts in the northeastern U.S.A. in 1826; it is also found in D.C. and Maine (Standley 2002). *Carex breviculmis* is easily distinguished from *C. caryophyllea* by its caespitose habit and lowest inflorescence bract longer than the inflorescence. *Carex caryophyllea* is colonial from creeping rhizomes and has an inconspicuous lower inflorescence bract shorter than the inflorescence. In Mississippi, the habit of *C. breviculmis* is similar to species in section *Acrosystis*, but can be distinguished by its brown plant bases and long awned, green and hyaline pistillate scales when compared to the purple plant bases and acute, purple, green, and hyaline pistillate scales of *C. albicans* (willd.) Spengel var. *australis* (L.H. Bailey) Rettig and *C. nigromarginata* Schweinitz. In vegetative plants, *C. breviculmis* might be confused with *C. blanda* Dewey or *C. leavenworthii* Dewey, both weeds of turf, lawns, flower beds, and disturbed sites (Bryson 1985; Bryson & Carter 2008). The leaf color in vegetative *C. breviculmis* plants is a darker green than in *C. leavenworthii* and the widest leaf is much narrower than the widest leaf in *C. blanda*. The following description is based on specimens collected in Meridian, Mississippi during 2007 and 2008.

Carex breviculmis R. Br. Prodr. 242. 1810. (**Figs. 1–2**).

Plants densely caespitose from short rhizomes and fibrous roots; culms trigonous, 15–42 cm long, 0.7–0.9 mm wide, antrorsely scabrous; leaves dark to lime green, shorter than the culms, blades 3–20 cm long, 1.0–2.5 mm wide, leaf bases chestnut to light brown; inflorescence 3–4 spikes, pistillate spikes 2–3, 5.1–12 mm long, 3–4 mm wide, perigynia elliptic, 2.5–3.0 mm long, 0.8–0.9 mm wide, pubescent, 3–5 nerves per face, beak 0.8 mm long, bulging midway, pistillate scales 4.4–4.8 mm long, 0.7–1.2 mm wide, ovate to obcordate, acute to awned, awns 0.5–2.8 mm long, antrorsely scabrous, longest proximal; staminate spike 2.3–10 mm long, 1.2–1.8 mm wide, staminate scales 3.0–3.4 mm long, 0.8–1.1 mm wide, apex acute or awn to 0.5 mm long, antrorsely scabrous; bracts subtending lowest two pistillate spikes, sheaths 3–20 mm long, front hyaline, bract blades 1.2–10 cm long, 0.8–4.0 mm wide, proximal bract longer than inflorescence; achenes 1.4–1.6 mm long, 0.5–0.6 mm wide, trigonous, brown; stigmas 3, 0.5–0.7 mm long; style 0.5–0.7 mm long, swollen at base, base persistent forming swollen tubercle-like structure at achene apex; anthers 3, 2–2.2 mm long, 0.05 mm wide, filaments 2.8–3.2 mm long.

COLLECTIONS AND HABITAT DESCRIPTION

Carex breviculmis was first collected on March 23, 2007 from the Gypsy Cemetery in Meridian, Lauderdale County, Mississippi (Fig. 3). In 2007, the Gypsy Cemetery was heavily mowed during the summer and most of the *C. breviculmis* was observed growing under moderately shaded conditions beneath a large *Quercus nigra* L. near a fenceline with much less maintenance than the interior of the cemetery. During a visit to the Gypsy Cemetery in May 2008, *C. breviculmis* was observed in shaded and open areas growing in *Cynodon dactylon* (L.) Pers. and *Stenotaphrum secundatum* (Walter) Kuntze turf and around grave markers. Additional specimens were collected on May 5, 2007 from a site adjacent to Interstate 20 and a railroad that runs perpendicular to Interstate 20 through Meridian. At this site, plants were growing in the middle of an old, rarely used trail that parallels the railroad under shaded conditions in sandy, mesic soils, where the canopy is dominated by trees and shrubs approximately 15 years old. The vegetation is dominated by *Albizia julibrissin* Durazz., *Carex basiantha* Steudel, *C. digitalis* Willd. var. *floridana* (L.H. Bailey) Naczi & Bryson, *C. kraliana* Naczi & Bryson, *Carpinus caroliniana* Walter, *Cercis canadensis* L., *Dichanthelium commutatum* (Schult.) Gould ssp. *joorii* (Vasey) Fernald, *Fraxinus pennsylvanica* Marsh., *Hypericum hypericoides* (L.) Crantz, *Liriodendron*

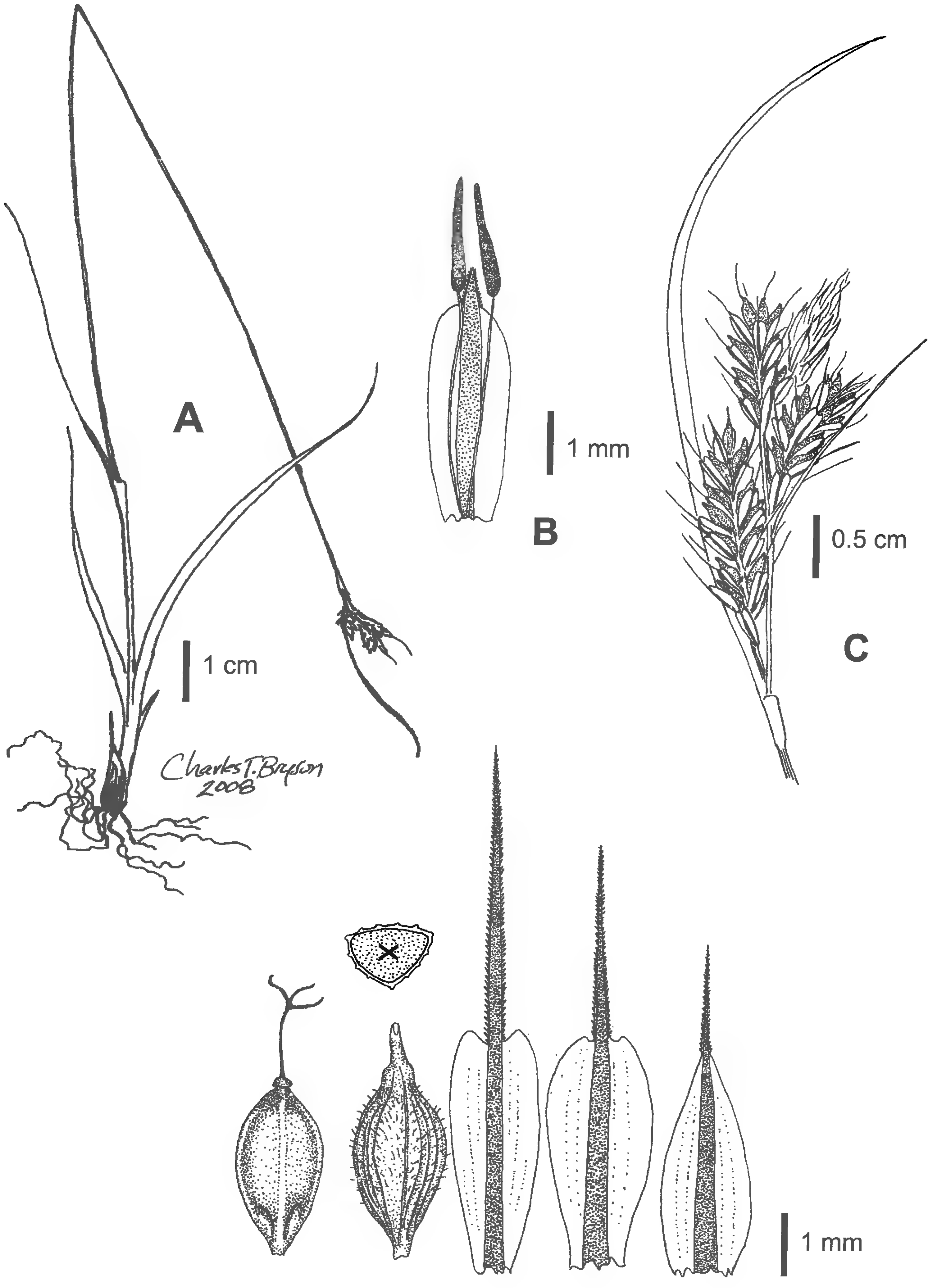

Fig. 1. Illustration of *Carex breviculmis*: A. plant habit (culm folded); B. abaxial view of staminate scale and anthers from midway on the staminate spike; C. inflorescence including subtending bracts and uppermost sheaths; D. achene with stigma and style attached; E. perigynium cross section (above) and side view (below); F. adaxial view of pistillate scales from proximal to distal (left to right) on the pistillate spike. B drawn from *Majure 2119 et al.* (ctb) and A and C–F drawn from *Majure 2334* (ctb).

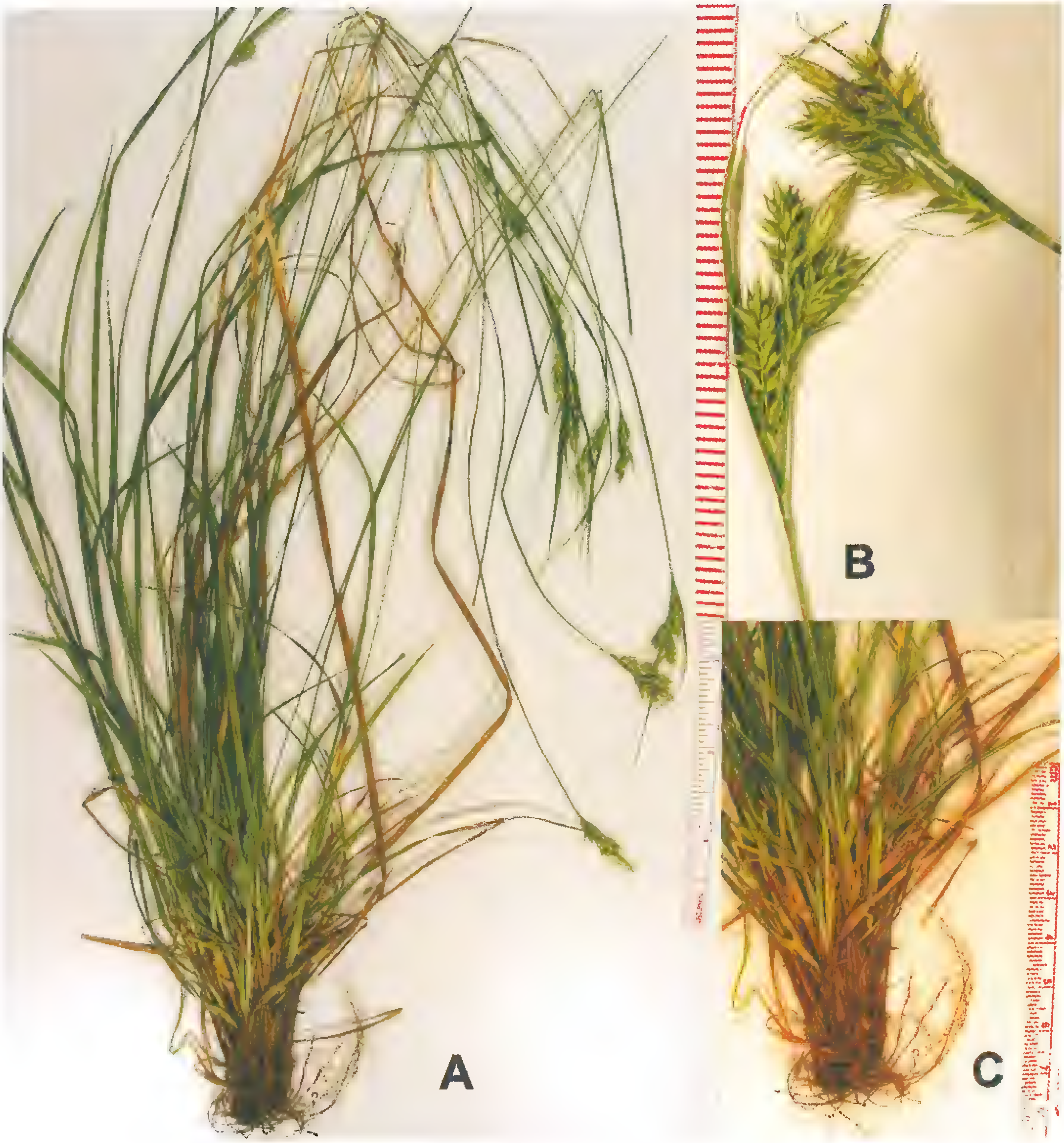

Fig. 2. Photos of *Carex breviculmis* R. Br. collected in Lauderdale County, Mississippi, *Majure 2334*: A. plant habit (culms folded); B. inflorescence; and C. base of plant.

tulipifera L., *Lonicera japonica* Thunb., *Luzula echinata* (Small) F.J. Herm., *Morella cerifera* (L.) Small, *Rubus trivialis* Michx. and *Symphyotrichum lateriflorum* (L.) A Löve & D. Löve. On December 23, 2007, when the first two sites were revisited, the densely caespitose clumps of this *Carex* species were still dark green and had not been killed by winter frosts.

Early in March 2008 and again in May 2008, *C. breviculmis* was collected at yet another cemetery in Meridian and from a highly disturbed vacant lot behind a fast-food restaurant. At the second and larger cemetery, Magnolia Cemetery Perpetual Care, thousands of *C. breviculmis* plants were observed in open and

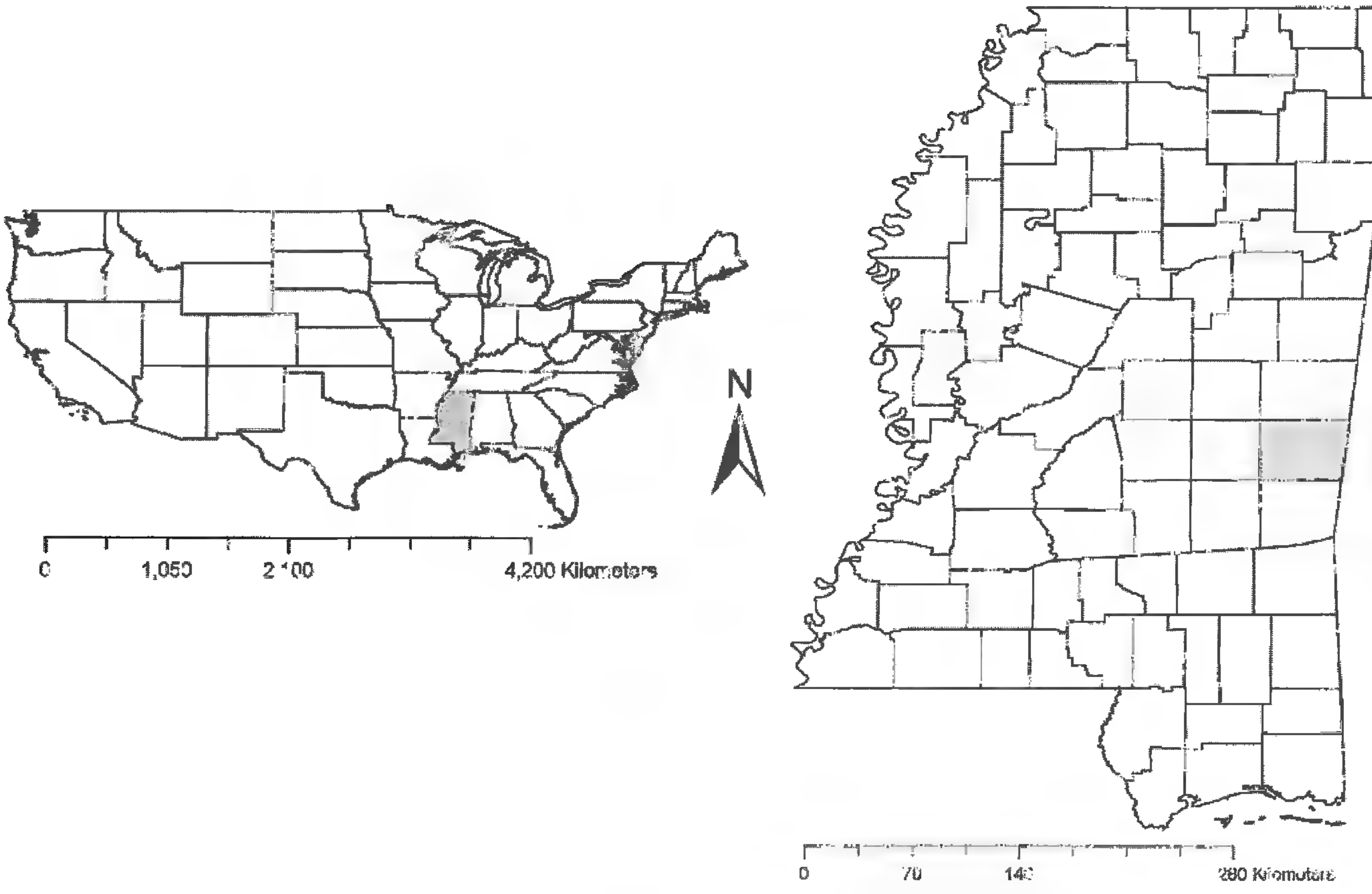

Fig. 3. The location of *Carex breviculmis* R. Br. in Lauderdale County, Mississippi, U.S.A.

shaded areas, even growing out of cracks in cement, around large headstones and around poorly mowed areas under large *Magnolia grandiflora* L. trees. The soils at both cemeteries ranged from sand to sandy loams, while those from along the trail and behind the fast-food restaurant were loam to silty loam soils.

We have observed a high degree of morphological variation in this species, even within the same population. Plants growing out of cement, headstones or in compacted, drier soils tended to be smaller than plants which were found near tree bases or in slight depressions. Also, the "lazy" culms of plants growing in open, short lawn areas tended to fall over and lay flat on the ground, whereas those growing next to some structure (cement, base of tree, etc.) tended to remain nearly erect or merely droop but not fall to ground level. It appeared that this could be advantageous to the species when growing in heavily mowed areas, in that sexual reproduction still could take place under such conditions.

Voucher specimens. **U.S.A. MISSISSIPPI. Lauderdale Co.:** Meridian at Gypsy Cemetery off of 8th St. at the junction with 40th Ave. 32.36384°N, 88.71913°W, 23 Mar 2007, *L.C. Majure 2119 with C. Doffitt & J. Hill* (MISSA, USMS, herb. Bryson); 10 May 2008, *L.C. Majure 3214 with C.T. Bryson* (FLAS, TENN, US); *C.T. Bryson 22690 with L.C. Majure* (BRIT, CHSC, DAV, DOV, DSC, FSU, GH, IBE, JSU, MICH, MISS, MISSA, MMNS, MO, NY, SWSL, TENN, UARK, USCH, USMS, VDB, VPI, VSC, WIN, herb. Bryson); S of I-20 E and Meridian adjacent to RR track just W of Mt. Barton at the end of frontage road. from 31st Ave. S 32.34856°N, 88.71904°W, 5 May 2007, *L.C. Majure 2334* (DOV, FLAS, MISS, MMNS, MO, SWSL, VSC, herb. Bryson); 10 May 2008, *L.C. Majure 3215 with C.T. Bryson* (FSU, NCU, US, USMS, WIS); *C.T. Bryson 22697 with L.C. Majure* (BRIT, CHSC, DAV, DOV, DSC, FSU, GH, IBE, JSU, MICH, MISS, MISSA, MMNS, MO, NY, SWSL, TENN, UARK, USCH, USMS, VDB, VPI, VSC, WIN, herb. Bryson); Meridian, Magnolia Cemetery Perpetual Care off of 23rd. Ave. ca. 0.5 km N of 20th St. and ca. 200 m E of northernmost entrance 32.38801°N, 88.69965°W, 15 March 2008, *L.C. Majure 2877* (FLAS, MISSA); 10 May 2008, *L.C. Majure 3213 with C.T. Bryson* (BM, FSU, GA, LSU, TEX, US, USMS, WIS); *C.T. Bryson 22685 with L.C. Majure* (BRIT, CHSC, DAV, DOV, DSC, FSU, GH, IBE, JSU, MICH, MISS, MISSA, MMNS, MO, NY, SWSL, TENN, UARK, USCH, USMS, VDB, VIP, VSC, WIN, herb. Bryson); Meridian, Magnolia Cemetery Perpetual Care off of 23rd Ave. ca. 0.5 km N of 20th St. and ca. 250 m E from southernmost entrance 32.38571N, 88.69948W, 10 May 2008, *C.T. Bryson 22688 with L.C. Majure* (DOV, MO, VSC, herb. Bryson); Meridian, off of Frontage Rd. North adjacent to I-20 behind Arby's restaurant just S of Meridian and Bigbee Railroad and E of 18th Ave. S; 32.35774°N, 88.68607°W, 10 May 2008, *L.C. Majure 3198 with C.T. Bryson* (FLAS, MISSA); *C.T. Bryson 22705 with L.C. Majure* (SWSL, herb. Bryson).

DISCUSSION

The source of introduction of *C. breviculmis* into the southeastern U.S.A. can only be speculated at this point. The city of Meridian was established in 1860 and has been an important railway center, where current intersecting railroads joined the city to the south as far as Mobile, AL and to the west as far as Vicksburg, MS (Allgood 1983). The *C. breviculmis* discovered in Meridian could have come into the country via goods being shipped from coastal ports into the interior U.S.A. by railway. One population of *C. breviculmis* is directly adjacent to the main railroad running through the city, and the other populations are located close to the downtown area, where the railway is not very far away. Also, the Meridian Air Force Base (Key Field) is within 1 km of one population of *C. breviculmis*. From the base, flights come and go from all over the world. Key Field is currently the home of the Air National Guard 186th Air Refueling Wing and the 185th Army Support Facility. It is possible that this species could have been introduced inadvertently as a "hitchhiker" on air-crew, troops, airplane machinery or cargo from Asia.

Another potential source of entry is the Rose Hill Cemetery, more commonly known as the Gypsy Cemetery, in Meridian. This cemetery has been the burial site for the Gypsy royal family since 1915 and has received many international visitors (Turnage 1999). The once Queen and King of the Gypsies in the U.S.A. and other Gypsy royalty are buried in the cemetery. Clothing and shoes of visitors or items brought to the cemetery for placement on gravesites could have been contaminated with seeds of *C. breviculmis*.

Carex breviculmis is cited as a weed (Moore & Edgar 1976; Moody 1989; Simpson & Inglis 2001; Global Compendium of Weeds list 2007; Bryson & Carter 2008) and has not been recorded as an ornamental (Bryson & Carter 2008) and does not seem to be in the nursery trade in the U.S.A. (A. A. Reznicek personal comm.). In the four localities where *C. breviculmis* has been found in Meridian, three of the sites contain relatively large populations ranging from thousands of plants at one cemetery to hundreds of plants at the other two, smaller sites. This species appears to be weedy in two of the largest cemeteries in Meridian, where it was common in *C. dactylon* and *S. secundatum* turf. Based on our observations, the size of populations, and the distance between sites, we suspect that *C. breviculmis* has been in the Meridian area for several decades. Additional surveys are needed to determine the distribution of *C. breviculmis* in Meridian and adjacent areas. Further dispersal of achenes and live plants is likely on contaminated mowing, construction, and grave digging equipment.

ACKNOWLEDGMENTS

We thank the University of Florida Herbarium (FLAS) for invaluable library access and MO for specimen loans of *Carex breviculmis* (including *C. leucochlora)* and other closely related species in sect. *Mitratae*. We also thank Monica Arakaki for reviewing our Spanish abstract. We also thank Richard Carter, Gary N. Ervin, Robert F.C. Naczi, A.A. Reznicek, and David J. Rosen for helpful comments and reviews of the manuscript. This work was supported in part by funding from the USGS Biological Resources Discipline (#04HQAG0135) to Gary N. Ervin, Mississippi State University.

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BOOK REVIEW

Kelly Allred. 2008. **Flora Neomexicana, I: the Vascular Plants of New Mexico. An Annotated Checklist to the Names of Vascular Plants, with Synonymy and Bibliography.** (no ISBN, hbk.). Published on demand by author. (**Orders:** www.lulu.com). $60.00, 617 pp. 6" × 9".

Having been a co-author of a similar, but much abbreviated catalog of the Colorado Flora (Weber & Wittmann 1992), I am impressed by the Roman numeral "I" following the title. This seems to indicate that future volumes plan to provide similar catalogs to the misnamed "lower" plants, including at least lichens and bryophytes. Let us hope that the project prospers. Most popular floristic books create a false assumption that vascular plants are the end and all of botanical biota.

This volume is an important milestone. Much more than the checklist named on the cover, the introduction presents an overview of the extent of the territory, its geological history, soils, ecoregions, vegetation types, and a lexicon of terms applying to these features. Also included is a brief history of the science from the Mexican Boundary Survey and the Pacific Railroad surveys up through 1915 and the lives of the prominent field botanists who scoured the terrain. A special section lists species of special concern, endemics, aliens, statistics on numbers of categories, and noxious weeds, providing answers to queries on these timely topics.

The checklist treats the major groups of plants: Ferns and Fern Allies, Gymnosperms, Dicots, and Monocots, each with their families in alphabetical order. There is a page-index to the families and genera. The catalog, while necessarily headlining the scientific name that the author prefers, does not decree its proper usage, for the synonyms are drawn from the previous reports for New Mexico, citing the references in which they have been used. Thus one is free to select the name suiting the user's taxonomic philosophy. For example, in the Asteraceae, under the family there are references to the most recent literature. Under each genus, one or more citations lead one to pertinent papers. References (conveniently abbreviated) justify inclusion of the species in the list.

Unfortunately, in these times, such a catalog becomes obsolete as soon as it is published. The *Flora of North America*, now in publication midstream, will make it necessary for future botanists—amateur and professional—to decide which names to use in instances where the new and immature disciplines of cladistics and molecular biology boldly decree the validity of emerging information dealing with phylogeny. I hold that floras try to deal as best they can with traditional morphological features implying relationships. The language and mechanics of the new disciplines is not familiar enough to the majority of practical botanists. We find it interesting to learn what the new school is saying about evolutionary descent, but it is hard for practitioners to test their findings in terms of the scientific method.

In practice, I feel that with botanical nomenclature in such a state of flux, I can honestly urge the workers in the field to select those names that they are familiar with and that are justified by their experience. After all, scientific names are the shortest expression of a point of view. They are not etched in stone. And the *Catalog of the New Mexico Flora* is precisely what the practitioner needs to do satisfactory work.

This volume, while its readership may be small, is an extremely important one. How many thousands of hours did it take to make this compilation? Such a treatment is a strong endorsement of the value of herbaria and hard-copy literature. All of the names listed here are backed up with vouchers in some herbarium.

My criticisms are minor; they simply speak to things that I wish were included or omitted. Most of them would have doubled the size of the book. I miss not seeing running heads. I deplore the new-age habit of creating a "common name" for all species. Who will ever use them? Lloyd Shinners would turn over in his grave. Instead of all the spurious "common" names, I would have been more interested in seeing the Spanish names for common species, be their uses medicinal or gastronomic. I am sorry to see that the phylogenetic taxonomies created by cladistics and molecular biology have been uniformly accepted as if they were the last word in nomenclature. I miss literature citations of the families, genera, and species. I miss specimen citations for species known from only one or a few collections, and the herbaria housing the vouchers.

The interior western states are still remnants of a botanical frontier. We lack the great herbaria, libraries, comrades-in-arms, amateurs, university curricula, financial support, and public understanding that botanists have come to expect and enjoy on the earlier-settled east and west coasts. The area is immense, the zones of activity small, and the flora still yielding new species and genera. Here many of us have worked alone for our entire careers, without opportunity for first-hand intellectual exchange. It is gratifying to see that New Mexico is alive and kicking, and its botanists should be congratulated on the resurgence of solid research on the ground.—*William A. Weber, Prof. Emeritus, Curator, University of Colorado Herbarium, Boulder, Colorado 80309, U.S.A., bill.weber@colorado.edu.*

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VASCULAR FLORA OF C. BICKHAM-DICKSON/RED RIVER EDUCATION AND RESEARCH PARK, CADDO PARISH, LOUISIANA: AN OXBOW LAKE COMMUNITY, WITH COMMENTS ON EXOTIC/NATIVE SPECIES RATIOS

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ABSTRACT

A floristic inventory was conducted as part of a biological assessment of the C. Bickham-Dickson/Red River Education and Research Park, Caddo Parish, Louisiana. The goal was to provide a baseline checklist of the flora of this oxbow lake area. An additional goal was to provide an overview of disturbance history and the exotic species of the flora. The flora consists of 318 species of which 68 (21%) are not natives.

RESUMEN

Se realizó un inventario florístico como parte de una evaluación biológica del C. Bickham-Dickson/Red River Education and Research Park, Caddo Parish, Louisiana. El objetivo fue realizar un listado base de la flora de esta área lacustre. Un objetivo adicional fue aportar una visión de conjunto de la historia de las perturbaciones de la flora y especies exóticas. La flora consiste en 318 especies de las que 68 (21%) no son nativas.

INTRODUCTION

River systems have undergone drastic modification since the beginning of agriculture. For example, the Nile and its flood plain have been under intense human pressure and, consequently, modification for thousands of years (De Villiers 2000). In the New World, both Native Americans and Europeans often selected rivers and their floodplains for farms, plantations, and cities. Whether we speak of Cahokia or St. Louis, we can see that these sites were desirable and came under human occupation and thus modification early on. Today, there are few major river systems or even parts of major river systems that approach pristine conditions (Noss et al. 1995; Outwater 1996; DeVilliers 2000).

The Red River is no exception. Caddo Indians inhabited its floodplain and followed later by European settlers and their African slaves (Perttula et al. 2008). The first ecologist/botanist to study the Red River was Peter Custis, naturalist on the ill-fated 1806 Red River Expedition (Flores 1984; MacRoberts et al. 1997; MacRoberts & MacRoberts 2004; Hardy 2008). Only two of Custis' plant specimens survive, but the descriptions provided by both Custis and Thomas Freeman (leader of the expedition) are tantalizing: prairies, swamps, cedar forests, and canebreaks lined the Red River. The next important ecological information about the Red River's ecology was the land survey of the 1830s (MacRoberts & MacRoberts 2005). A recent conference, *The Freeman and Custis Red River Expedition of 1806: Two Hundred Years Later,* focused attention on the Red River and Upper West Gulf Coastal Plain and concluded that very little is known biologically about it and that no inclusive study has been undertaken to elucidate the ecology of this system since the early nineteenth century (Bragg 2008; MacRoberts & MacRoberts 2008).

In this paper, we undertake to describe the floristics of the C. Bickham-Dickson/Red River Education and Research Park (Park hereafter), a highly modified oxbow system on the Red River floodplain. We also

J. Bot. Res. Inst. Texas 2(2): 1389 – 1406. 2008

briefly consider the relationship between site disturbance and native/non-native (exotic) species ratios: "non-native" or "exotic" referring to introduced species from outside the United States.

There were very few exotic species in North America in 1491. Only cultivars brought to North America from Central America and Mexico were imports. Now, 20 to 35 percent (depending on author) of the 20,000 odd species found in North America are exotics from all parts of the world (Stuckey & Barkley 1991).

While there is an extensive literature on exotic species (Elton 1958; Simberloff 2004; Sax et al. 2005) and much data on the relationship between percentage of exotic species in a flora and the overall size of the flora, there is little quantitative data and even less experimental data on the relationship between disturbance history and the exotic/native flora. Nonetheless, it is widely recognized that highly disturbed sites such as cities and urban parks have a high percentage of exotics (ca. 20–60%); whereas undisturbed sites have much lower percentages (ca. 0–10%) (Fox & Fox 1986; McIntyre & Lavorel 1994; Basinger et al. 1997; Stalter et al. 1997; Stapanian et al. 1998; Lonsdale 1999; McKinney 2002, 2006; Harcombe et al. 2007). Percentage of exotics, therefore, can be used as an indicator of degree of site disturbance (Gilliam 2007).

STUDY SITE

The Red River originates in the Great Plains and flows 2,200 km east and southeast until it reaches the Mississippi River in central Louisiana. Red and brownish red silt and clay particles, eroded from mainly Triassic and Permian rock, give the river its distinctive color. From north central Texas to the Mississippi River, the river is sluggish with a low-lying, flat, extensive, Pleistocene/Holocene floodplain valley five to thirty km wide with oxbows, sloughs, and backwater swamps. Flanking the floodplain at its lower reaches are woodlands dominated by oak, pine, and hickory. As the glaciers receded and sea levels rose, the gradient of the river lessened, causing it to braid and meander widely, resulting in deposition of alluvium that we see today. The floodplain slope is gradual (Newkirk & Mueller 1980; Triska 2008).

Hunters entered the Red River area at least 12,000 years ago near the end of the last glaciation, long before the present climate and biota were established. Horticulture came much later, probably no more than 3000 years ago. The effect of Native Americans on the ecology is not known, but there is considerable debate on this matter (e.g., Mann 2005). The Red River was first seen by European explorers in the sixteenth century. Its lower reaches were colonized by the French in the eighteenth century, but because the "Great Raft"—an immense logjam—blocked the river, its upper part was not fully explored until the nineteenth century (Flores 1984). In 1806, the Freeman and Custis expedition went through and around the raft to near the present day border of Oklahoma and Arkansas (Flores 1984; MacRoberts & MacRoberts 2004; Hardy 2008). Marcy and McClellan (1854) completed the exploration of the river in the mid-nineteenth century. The raft, which extended in the mid-eighteenth century from Natchitoches to Shreveport was cleared by the 1850's but immediately reformed above Shreveport and grew by accumulation of driftwood to almost the Arkansas border by 1873. The raft dammed the river, causing extensive flooding of low-lying areas and the creation of raft-lakes. Cottonwood, cypress, and red cedar apparently made up the bulk of the raft, and older sections were covered with herbaceous plants and shrubs. The raft was finally completely cleared by 1873, with the result that raft-lakes drained and the River was navigable. Rapid exploitation of the floodplain and the establishment of farms, plantations, towns, and cities followed (Humphreys 1971; Flores 1984; Triska 1984, 2008; Bagur 2001).

Over the last two centuries, the river and its floodplain ecosystems have undergone drastic modification. Much of the landscape was converted to farms and plantations and eventually the river was modified by leveeing, straightening, and damming. The floodplain was severely modified by agriculture and urban sprawl. The once continuous forest of varied communities that covered hundreds of thousands of hectares is now virtually gone. Cypress swamps, willow riverbank shrublands, and cottonwood forests hang on while some floodplain communities such as cedar forests, cane brakes, and prairies have vanished entirely (MacRoberts et al. 1997; MacRoberts & MacRoberts 2008a).

Although floodplains in general have received substantial phytogeographical and ecological attention and there are numerous generalized descriptions and classifications according to hydrologic conditions, soils, and vegetation (e.g., Sharitz & Mitsch 1993; Messina & Conner 1998; Mitsch & Gosselink 2000), the Red River floodplain is poorly known, especially floristically (see Newkirk & Mueller 1980). Aside from checklists of parishes and communities along the Red River, its last floristic survey was in 1806. It has never been the subject of an ecological assessment (MacRoberts & MacRoberts 2008b). The most important literature dealing with local ecology is small. MacRoberts (1979) and MacRoberts and MacRoberts (2006) produced a flora of Caddo Parish. Van Kley and Hine (1998) described the wetland vegetation of Caddo Lake—a remnant raft-lake. There have been several studies of floodplain forests in eastern Texas (e.g., see literature in Mundorff 1998). MacRoberts and MacRoberts (2005), using original land plats, described the 1830s woody vegetation of Caddo Parish. Diggs et al. (2006) and Van Kley (2006) summarized the community types of eastern Texas and western Louisiana. Ware (1956) briefly described the vegetation on a sand bar near Natchitoches, and Teague and Wendt (1994), concentrating on Bossier and Caddo parishes, conducted the first parish-wide comprehensive survey of high quality natural communities in Louisiana, only two of which were floodplain communities. Two non-quantified reports round out the list: Palmer (1923) provided an anecdotal report of the Red River forest at Fulton, Arkansas, and the Henderson State University Biology Department (1979) prepared a modest "biological inventory of the Red River waterway" for the Corps of Engineers.

The Park is located between the campus of Louisiana State University in Shreveport and the Red River (Sexton-Gordon 2004) (Fig. 1). It is 236 ha and includes an 81 ha oxbow lake created in the spring of 1945 by the change in course of the river during a flood. The Park ranges in elevation from about 44 to 49 m above sea level. It periodically floods and its oxbow lake is only a few meters deep. To the west is a man-made levee with adjacent barrow-pit and to the east is the Red River, which is now impounded and is in reality a linear lake. Natural levees occur adjacent to the river and the oxbow. The floodplain is about 15 km wide at this point. The Park was once within the area of the Great Raft. The part of the raft adjacent to the Park was cleared between 1833 and 1837.

The Park shows the classic geologic structure of river meander systems and oxbow lakes (Sharitz & Mitsch 1993). The river channel meanders through the floodplain, transporting, eroding, and depositing alluvial sediments. Natural levees adjacent to the channel result from deposition of coarser sands when floods overtop the banks. Point bars form from sedimentation on the convex side of river curves and soon support vegetation, which stabilizes the soils. At the same time, on the concave (cut bank) side of the river the relatively fast water moving cuts away the bank. As the river migrates across the floodplain, meander scrolls (ridges and swales) form, giving the area appreciable topography. Oxbow lakes form when the meander cuts off at its neck, and a new channel forms. The deposited soils are generally described as "riverwash:" "recently deposited, slightly acid to moderately alkaline sand, silt, and clay." "Most of the material is sandy, but there are many thin layers of clay and silt. The profiles are not uniform from place to place. At frequent intervals during floods, fresh material is deposited or several feet of material is washed away. In this manner the upper layers change from one year to another. The slopes are uneven. The slope range is generally from less than 1 percent to 3 percent, but there are some short slopes of as much as 5 percent" (U.S.D.A. Soil Conservation Service 1959:41–42).

The land that encompasses the Park first came under individual ownership with the 1801 Spanish Land Grant to Francois Grappe, son of a French father and Caddoan mother, born at La Harpe's Post north of the Great Bend probably in what today is Bowie County, Texas. Grappe was a trader, interpreter, guide, and cattle runner. He was centrally involved in the Freeman and Custis Red River expedition as guide and interpreter or supplier of interpreters and guides to the ill-fated expedition. The grant given to Grappe consisted of four leagues along the Red River in what is today south Caddo Parish. The grant was recognized in 1835 in the Caddo Cession and passed to Grappe's sons, who in turn sold it to Jahiel Brooks, Caddo Agent, who in turn managed to lose it to creditors by the 1850's. Neither Grappe nor his sons ever lived on this land nor is there any evidence that they exploited it in any way. The first white settler of what is today the

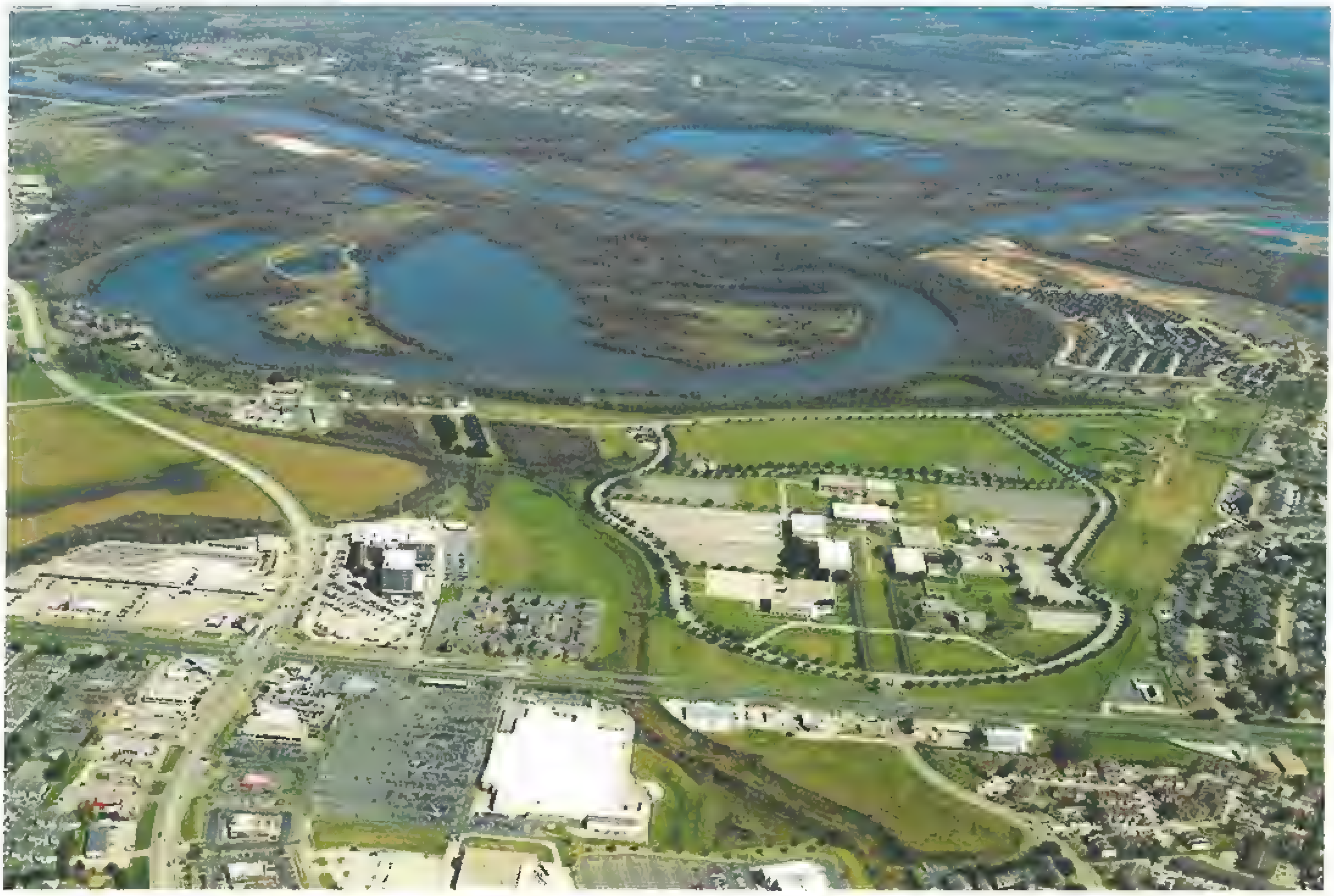

Fig. 1. Aerial view of Bickham-Dickson/Red River Education and Research Park and surrounds including Louisiana State University in Shreveport. Photo by Harris Photography, permission of Jennifer LaPierre, Media and Public Relations, LSUS.

Park appears to have been Samuel Norris. Norris, since the 1820's, had lived on "Rush Island"—a part of the Grappe claim, either in the Park or just south of it. What Norris used the land for is not entirely clear but apparently hogs, cattle, and farming were involved. His claim was eventually disputed and it too went to creditors at the same time as did Brooks'. By the 1890s, the land had become part of the Fullilove Plantation (O'Pry 1928; Flores 1984; Henrici 1985). The site has subsequently been cleared, grazed, plowed and planted with forage crops, and used as a horse stables and riding area.

In 1839 at the time of the General Land Office land survey, the Red River was a little to the east of its present position at the Park. By 1890, it had meandered halfway across the Park and was moving steadily west. In 1945, its channel ran along what is now the oxbow lakes in the Park. But during the spring of that year, the river overflowed and cut a new channel through the narrow neck of land to the east of the park and established its present channel (Advisory Committee Report 2002). Thus, geologically the area of the Park is not old. With the exception of those soils on its extreme western edge, all the soils have been reordered over the last two centuries.

Construction of the Red River Navigation Project, which was authorized by Congress through the Rivers and Harbors Act of 1968, led to the development of five locks and dams downstream. When the Corps of Engineers completed the last structure, Lock and Dam 5 about 30 km downstream in late 1994, the average river level at the Park was increased to a post-construction pool stage of 147 feet above mean sea level. The lake level is currently erratic and depends on river flood stage and other internal factors.

Teague and Wendt (1994) give additional background information on climate, geology, and history of the area. Prior to the construction of locks on the river in the 1990s, July to December was the period of lowest water, and January to June the period of highest water. Rainfall is approximately 115 cm per annum.

The City of Shreveport and the State of Louisiana jointly purchased the site in 1980 and named it C.

Bickham Dickson Park. The Park was used solely for recreational activities such as sport fishing and boating until the mid-1980s when Louisiana State University in Shreveport began biological and geological research at the site. In 2000, the City entered into an agreement with Louisiana State University in Shreveport under which the University would be allowed to utilize the park as a "living laboratory" for natural resource education and research. Under the agreement, Louisiana State University in Shreveport would manage the Park as Red River Education and Research Park. Research at the Park, which also includes the development of innovative environmental monitoring technologies, has been conducted as part of the ongoing environmental studies at Louisiana State University in Shreveport, and other academic and research endeavors of the university.

The Red River floodplain vegetation in and surrounding the Park consists primarily of what has been called "batture" (Lester et al. 2005), "*Populus deltoides* temporary flooded forest alliance" (Weakley 1998), or seasonally flooded river floodplains, and semi-permanently flooded swamps (Van Kley 2006). From one side of the Red River floodplain to the other, the following woody species occur: cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), sycamore (*Platanus occidentalis*), black willow (*Salix nigra*), hackberry (*Celtis laevigata*), boxelder (*Acer negundo*), pecan (*Carya illinoinensis*), rough-leaf dogwood (*Cornus drummondii*), persimmon (*Diospyros virginiana*), mulberry (*Morus rubra*), bois d'arc (*Maclura pomifera*), swamp privet (*Forestiera acuminata*), cypress (*Taxodium distichum*), button bush (*Cephalanthus occidentalis*), honey locust (*Gleditsia triacanthos*), and elm (*Ulmus* spp.). Historically, there were virtually no oaks (*Quercus* spp.), pines (*Pinus* spp.), sweetgum (*Liquidambar styraciflua*), magnolia (*Magnolia grandiflora*), or hickories (*Carya* spp.) other than pecan on the floodplain. The species directly adjacent to the river itself were typically also at the farthest edge of the floodplain just before the uplands are reached. At the floodplain edge, there is an abrupt elevation change (10 to 30 m) and a vegetational transition in which pines (*Pinus*), oaks (*Quercus*), hickories (*Carya*), magnolia (*Magnolia*), and sweetgum (*Liquidambar*) dominate and floodplain species drop out. These species were present in 1830, and they are present today (MacRoberts & MacRoberts 2005). The edge of the floodplain is often marked by a bayou (e.g., Bayou Pierre) just before the uplands and the floristic transition.

METHODS

Beginning in February 2003 and continuing through November 2007, we regularly surveyed the Park for flora by walking through all areas. Specimens were collected, identified using local Floras (e.g., Smith 1994; Diggs et al. 2006), and deposited at Louisiana State University in Shreveport herbarium. Nomenclature generally follows Kartesz and Meacham (2005). We surveyed the Park for community types.

We reviewed the botanical literature for studies of the flora of different land use areas such as parks, research stations, natural areas, counties, states, etc., to obtain data on disturbance and native/exotic ratios. The review was not exhaustive but only meant to sample such areas. We confine our list to studies conducted during the last decade because, as Small and McCarthy (2001) point out, there are an ever increasing number of exotics in the flora.

RESULTS AND DISCUSSION

We found 318 species at the Park, 68 (21%) of which were exotics. These are listed in the Appendix.

The main plant associations that we have separated in the Park are:

Willow forest.—Willow (*Salix*) forest, which sometimes includes sycamore (*Platanus occidentalis*) and cottonwood (*Populus deltoides*), occupies moist to wet soils in periodically flooded river and lake edges and other shallow wet areas. It is this community that colonizes sandbars and other recently scoured areas.

Lake side/inundated non-scoured areas.—This is a continuation of the previous community but is associated with periodically flooded/wet areas such as lake edges and swales. Many species occur in this area including willow (*Salix*), button bush (*Cephalanthus occidentalis*), boxelder (*Acer negundo*), cypress (*Taxodium distichum*), and sycamore (*Platanus occidentalis*) in small numbers. Grasses and sedges and many other herbaceous plants also occur. Here also is vegetation growing on floating logs, tree stumps, and the base of those woody species that inhabit lake margins, such as button bush.

Open water with floating vegetation.—Duckweed (*Lemna, Spirodela*) sometimes occurs as a continuous green matt on the lake surface. Mosquito fern (*Azolla caroliniana*) can be common. Water-lotus (*Nelumbo lutea*) is dense in one area of the oxbow lake. Coontail (*Ceratophyllum demersum*) and hydrilla (*Hydrilla verticillata*) occur in many areas, usually in shallow water where they can become very dense. Algae sometimes form mats on top of shallow-growing *Ceratophyllum*.

Sandbar.—Because the river is now controlled by dams and locks, natural sandbars do not form. Old aerial photographs show sandbars adjacent to the Park. Willow (*Salix nigra* and *S. exigua*) forest is the community that first colonizes sandbars.

Cottonwood-sycamore-hackberry-ash-pecan forest.—This forest type dominates the middle to higher elevations of the Park, notably the ridges and levees. Any combination of these species, with lesser amounts of honey-locust (*Gleditsia triacanthos*), bois d'arc (*Maclura pomifera*), and boxelder (*Acer negundo*), can occur. Willow is also found here in swales. The understory is predominately rough-leaf dogwood (*Cornus drummondii*). The herbaceous groundcover is sparse, but poison ivy (*Toxicodendron radicans*) and *Juncus* and sedges can be common.

Open (Old) fields.—Open fields make up a large percentage of the Park. These were previously pasture and were planted with legumes and grasses for hay and pasturage. This community contains the highest number of exotic species. The fields typically have scattered cedar (*Juniperus virginiana*), bois d'arc (*Maclura pomifera*), and honey-locust (*Gleditsia triacanthos*).

Ruderal.—The Park contains other areas, such as roads/road sides, mowed areas, ragweed (*Ambrosia trifida*) "forests," and in some places, dodder (*Cuscuta*) covers large areas. These areas are highly disturbed.

We found many studies of undisturbed through highly disturbed sites in which the total flora and number of exotics were given (Table 1). We graph these in Figure 2 by land use type and size of area simply to make the data in Table 1 more accessible.

As we have pointed out, received wisdom is that there is a correlation between percentage of exotics in a flora and site disturbance (McIntyre & Lavorel 1994; Stapanian et al. 1998; Withers et al. 1998; Lonsdale 1999; McKinney 2006; Gilliam 2007 and references therein). Predictors of exotic richness include years of European settlement, disturbance, and surrounding population density (McKinney 2002). Cities present dramatic examples of this with their precipituous loss of native species and gain of exotic species (McKinney 2006). Large areas such as states are highly disturbed and have high percentages of exotics (generally between 15 and 35 percent)(Rejmanek & Randall 1994): eastern Texas, for example, adjacent to Caddo Parish, has 18 percent exotics and Arkansas and Louisiana have 24 and 25 percent, respectively. States along the eastern and western coasts of North America are the most disturbed (longest occupied) and have the most exotics (Withers et al. 1998; Palmer 2008). Pennsylvania, for example, an eastern state much longer occupied by European settlers than eastern Texas, Louisiana, or Arkansas, has 37 percent exotics. County-sized areas tend to have slightly fewer exotics than states but basically rank with them. Madison County, Texas, has 14 percent exotics; Caddo Parish, Louisiana, has 17 percent; Giles County, Tennessee, has 21 percent. Natural areas and nature preserves tend to have fewer exotic species than do state and national parks (4 to 13 percent versus 12 to 17 percent, respectively). Heavily used urban parks have the most exotics (19 to 60 percent). Only very small areas remain without major disturbance and exotics; these are the sites frequently chosen by ecologists to study "natural" communities. Such small areas, often less than a hectare, may show no disturbance and may be entirely free of exotics (0 to 2 percent) even when surrounded by disturbed areas (Gilliam 2007 and references therein).

On the basis of the data in Figure 2, it would appear that only small landscapes remain in natural condition (i.e. without disturbance or exotics). All large landscapes ultimately include disturbed areas and presumably, therefore, exotics. But, size matters little as data on parks suggest: Central Park in New York City has 60% exotics and the tiny Castillo San Marcos Monument has 42%. While it would be ideal to develop

Table 1. Species richness, total area, and percentage of exotics for selected areas.

PARKS	Species	Area (sq km)	exotics %	Source
Central Park, NY	583	3.41	60	DeCandido et al. 2007
Castillo San Marcos Mt, FL	137	0.09	42	Zomlefer & Giannasi 2005
B-D Park, Caddo Parish, LA	318	2.36	21	This study
Middlesex Fells Park, Boston, MA	400	0.69	26	Harcombe et al. 2007
Pelham Bay Park, New York, NY	956		34	Harcombe et al. 2007
Highland Heights Comm.Park, OH	403	0.42	34	Jog et al. 2005
Shaker Median Park, OH	298	1.4	47	Delong et al. 2005
Botany Garden, Houston, TX	446	0.5	19	Harcombe et al. 2007
Mount Vernon, VA	270	0.8	26	Wells & Brown 2000
Fort Washington Nat. Park, MD	973	19.56	25	Steury & Davis 2003
STATES				
Pennsylvania	3318	119236	37	Coxe et al. 2005
Arkansas	3187	153270	24	Diggs et al 2006
Louisiana	3269	134226	25	Thomas & Allen 1993–1998
East Texas	3402	162134	18	Diggs et al. 2006
COUNTIES				
Greene, PN	890	1500	20	Coxe et al. 2005
Oktibbeha, MS	1148	1185	15	Leidolf et al. 2002
Caddo, LA	1405	2283	17	MacRoberts & MacRoberts 2006
Montgomery, AR	1110	2023	12	Marsico 2005
Giles, TN	1208	1582	21	Estes 2005
Coffee, MS	797	1732	16	Martin et al. 2002
Pike, AL	1190	1759	20	Diamond 2003
Yalobusha, MS	805	1305	15	Denley et al. 2002
Madison, TX	1071	1217	14	Neill & Wilson 2001
STATE PARKS				
Myakka River State Park, FL	731	116.86	12	Huffman & Judd 1998
Little Manatee State Park,. FL	523	9.8	17	Myers & Wunderlin 2003
Fall Creek Falls, TN	879	89	13	Fleming & Wooford 2004
NATURAL AREAS				
Turkey Creek, Big Thicket, TX	691	31.5	7	Brown et al. 2005
Hickory Creek, Big Thicket, TX	401	2.8	4	MacRoberts et al. 2002b
Big Sandy Creek, Big Thicket, TX	693	58	7	Brown et al. 2006a
Lance Rosier, Big Thicket, TX	694	101	10	Brown et al. 2006b
Rattlesnake Falls, TN	627	0.63	13	Estes & Walck 2005
Big Branch, LA	563	58.7	13	Rosen et al. 2003
Starkey Wilderness, FL	483	4.49	9	Furguson & Wunderlin 2006
Big Lake Bottom WMA, TX	459	16.85	5	Fleming et al. 2002
Beadle Barrens Preserve, IL	306	0.04	7	Edgin et al. 2005
Dean Hills Nature Preserve, IL	313	0.3	6	Feist et al. 2004
Stephenson Memorial Forest, KY	538	0.51	10	Thompson & Fleming 2004
Ouachita Mountains Biol. Sta., AR	337	1.54	7	MacRoberts et al. 2005
Pushmataha WMA, OK	447	76.9	7	Crandall & Tyrl 2006
Cooters Bog, Vernon Parish, LA	135	0.03	1	MacRoberts & MacRoberts 1993
Big Thicket, Wet Savanna, TX	135	0.06	0	MacRoberts & MacRoberts 1998a
Muck Bog, Anderson Co., TX	136	0.05	2	MacRoberts & MacRoberts 1998b
Kisatchie Prairie, Winn Parish, LA	137	0.03	1	MacRoberts & MacRoberts 1996
Beech Slope, Sabine Co., TX	120	0.03	1	MacRoberts & MacRoberts 1997
Longleaf pine uplands, LA	158	0.004	0	MacRoberts et al. 2002a
Engeling WMA, Anderson Co., TX	930	44.65	6	Singhurst et al. 2003

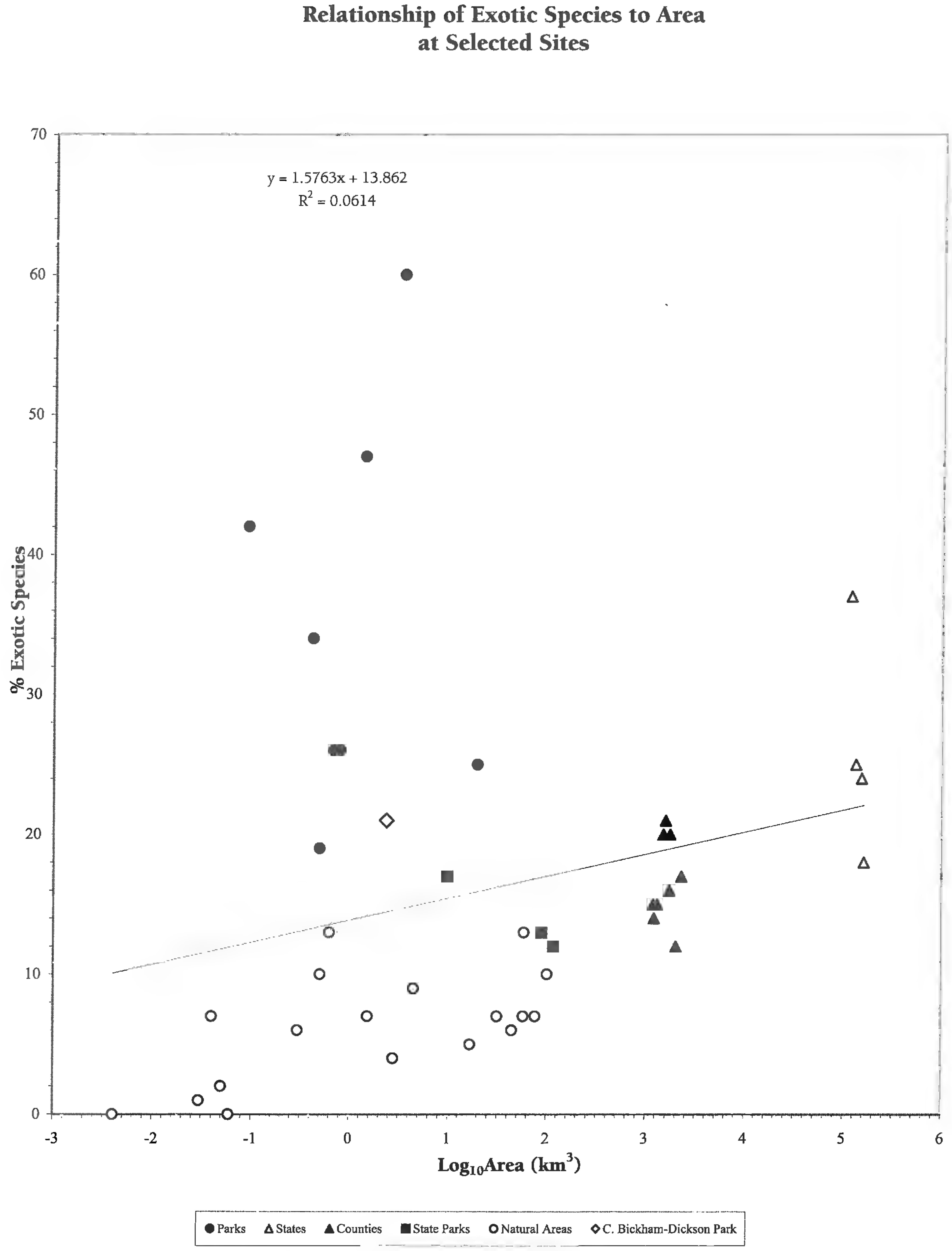

Fig. 2. Relationship of exotic species to area at selective sites. Data from Table 1.

a large data set comparing natural verses disturbed areas, size of area, history and time since disturbance began, the scope of this paper excludes that possibility. Nonetheless, there are such data sets being developed, for example, The Floras of North America project by Michael Palmer at Oklahoma State University (Palmer 2008)(not to be confused with the Flora of North America project) (see also McKinney 2002, 2006 for literature).

In the case of C. Bickham-Dickson/Red River Education and Research Park, the anthropogenic disturbance is great: it was a plantation and horse stables and is now a city park and a research area for a university. It has been cleared of canopy vegetation, and some sections have regenerated canopy. It has been grazed; it has been hayed and plowed. Part of it is mowed. There are old buildings. There are paved and dirt roads. There is a pier, and fishermen use both the bank and boats. Vehicles leave the roads, and off-road vehicles strip the ground of vegetation. Picnickers use the area, as do bird watchers. And the Park is surrounded by an ever increasing urban landscape: suburbs, a university, and lake-front housing. Today, the level and flow of the Red River is artificially controlled by the Corps of Engineers' lock and dam system, and in 2007 and 2008, most of the Park was flooded for several months causing die-off of many plant species not adapted to prolonged submersion. Twenty-one percent of the flora is exotic, a figure at the lower end of parks in our sample (Table 1), but many of these species are aggressive invaders: hydrilla (*Hydrilla verticillata*), Chinese tallow tree (*Sapium sebiferum*), Chinese privet (*Ligustrum sinense*), Japanese honeysuckle (*Lonicera japonica*), alligator weed (*Alternanthera philoxeroides*), Burmuda grass (*Cynodon dactylon*), and Johnson grass (*Sorghum halepense*).

But the worst is yet to come. In neighboring lakes, ponds, and sloughs other aggressive invaders are poised: giant salvinia (*Salvinia molesta* D.S. Mitch.) has just reached Caddo Parish and is choking nearby lakes; water-lettuce (*Pistia stratiotes* L.), a native of the Gulf coast, has recently arrived in Caddo Parish and undoubtedly will find its way into the Park; water hyacinth (*Eichornia crassipes* (Mart.) Solms) is in the Red River adjacent to the Park and it is only a matter of time before it invades; and brittle water nymph (*Naja minor* All.) has recently been found in Caddo Parish.

Unfortunately, in attempting to reconstruct what has happened to the Park, we do not know its "pristine" ecology and, therefore, what percent of native species has been lost. All we can reconstruct is the native tree flora from the1830s land plat data (MacRoberts & MacRoberts 2005). These data indicate that, while we still have the same native tree species we did in 1830, we also have some new ones, notably exotics such as Chinese tallow tree (*Sapium sebiferum*), silktree (*Albizia julibrissin*), and chinaberry (*Melia azedarach*).

As long as the Park is in a continual state of disturbance largely because of conflicting social interests and thus uses (Corps of Engineers, recreation, homeowners, business, state, city, and university), invasive weeds, native and exotic, will find the area ideal and continue to accumulate to the detriment of native species. Therefore, we can expect the Park to shift farther from a native state to a weedy and exotic state. Whether the current pressure on the Park will result in a catastrophic change in the ecosystems—some would say that it already has—or gradual change, remains unknown (Scheffer et al. 2001; Liu et al. 2007). But that the Park will change is certain, notably if managers attempt drastic intervention; for example, to control aggressive weeds such as hydrilla, when no one knows how much resilience the system has at present or, for that matter, if the system or parts of it has already shifted to a new equilibrium. In that case it will likely be impossible to restore to a previous state (Scheffer et al. 2001).

APPENDIX 1

Vascular plants found at Bickham-Dickson/Red River Education and Research Park. An asterisk * = exotic. Numbers without collector name are collection numbers of B.R. and M.H. MacRoberts. Other collectors are named. Specimens are deposited at Louisiana State University in Shreveport herbarium (LSUS). Common names are in parentheses after collection numbers.

Acanthaceae

Justicia ovata (Walt.) Lindau, 6486 (loose-flower water-willow)

Ruellia caroliniensis (J.F. Gmel.) Steud., 6802 (Carolina wild petunia)

Aceraceae

Acer negundo L., 6014, 6161, 6462, 6831 (boxelder)

Alismataceae

Echinodorus cordifolius (L.) Griseb., 6643, 6796, 6984 (creeping burhead)

Sagittaria graminea Michx., 6233, 6998 (grass-leaf arrowhead)

Amaranthaceae

**Alternanthera philoxeroides* (Mart.) Griseb., 6443 (alligator weed)

Amaranthus hybridus L., 6978 (amaranth)

Anacardiaceae

Toxicodendron radicans (L.) O.Ktze., (not collected) (poision ivy)

Apiaceae

Chaerophyllum tainturieri Hook., 6019 (hairy-fruit chervil)

Cynosciadium digitatum DC., 6447 (finger dogshade)

Hydrocotyle umbellata L., 6229 (many-flower marsh-pennywort)

Hydrocotyle verticillata Thunb., 6645 (whorled marsh-pennywork)

Sanicula canadensis L., 6661 (Canadian black-snakeroot)

**Torilis arvensis* (Huds.) Link, 6426 (spreading hedge-parsley)

Trepocarpus aethusae Nutt. ex DC., 6442, 6449 (whitenymph)

Apocynaceae

Apocynum cannabinum L., 6430, 6969 (Indian hemp)

Aquifoliaceae

Ilex decidua Walt., 6212, 6669 (deciduous holly)

Ilex opaca Ait., 5980 (American holly)

Asteraceae

Acmella oppositifolia (Lam.) R.K. Jansen, 6837 (opposite-leaf spotflower)

Ambrosia artemisiifolia L., 7001 (annual ragweed)

Ambrosia psilostachya DC., 6847, 7000 (perennial ragweed)

Ambrosia trifida L., 6762 (great ragweed)

Baccharis halimifolia L., 6759 (groundseltree)

Bidens laevis (L.) B.S.P., 6987, 6988 (smooth beggarticks)

**Carduus nutans* L., 6489, 6659 (nodding plumeless-thistle)

Chrysopsis pilosa Nutt., 6424 (soft golden-aster)

Conoclinium coelestinum (L.) DC., 6818 (blue mistflower)

Conyza canadensis (L.) Cronq., 6678, 6679, 6779 (Canadian horseweed)

Coreopsis tinctoria Nutt., 6508 (golden tickweed)

Dracopis amplexicaulis (Vahl.) Cass., 6433 (clasping coneflower)

Eclipta prostrata (L.) L., 6835 (false daisy)

Elephantopus carolinianus Raeusch., 6791 (Carolina elephant-foot)

Erigeron philadelphicus L., 6170 (Philadelphia fleabane)

Erigeron strigosus Muhl. ex Willd., 6431, 6675, 7002, 7003 (prairie fleabane)

Eupatorium capillifolium (Lam.) Small, 6778 (dog-fennel)

Eupatorium serotinum Michx., 6795, 6819 (late-flowering thoughtwort)

Gaillardia aestivalis (Walt.) Rock, Burden s.n. (fireweed)

Gaillarida pulchella Foug., 6027 (firewheel)

Gamochaeta pensylvanica (Willd.) Cabrera, 6018 (Pennsylvania everlasting)

Helenium amarum (Raf.) Rock., 6483 (yellowdicks)

Heterotheca subaxillaris (Lam.) Britt. & Rusby, 6677, 6685, 6803, 6825 (camphorweed)

Iva annua L., 6985 (annual marsh-elder)

Krigia caespitosa (Raf.) Chambers, 5972, 7369 (weedy dwarf-dandelion)

Lactuca canadensis L., 6649, 6758 (florida blue-lettuce)

Mikania scandens (L.) Willd., 6634 (climbing hempvine)

Packera obovata (Muhl. ex Willd.) W.A. Weber & A. Love, 5944 (round-leaf groundsel)

Pluchea odorata (L.) Vass., 6787, 6777 (sweetscent)

Pseudognaphalium obtusifolium (L.) Hillard & Burtt., 6849 (blunt-leaf rabbit-tobacco)

Pyrrhopappas pauciflorus (D.Don) DC., 7641, 7360, 6198 (dandelion)

Rudbeckia hirta L., 6481 (black-eyed-susan)

**Senecio vulgaris* L., 5945 (old-man-in-the-spring)

Smallanthus uvedalia (L.) Mackenzie ex Small, 7180 (bear's-foot)

Solidago canadensis L. var. *scabra* Torr. & Gray, 6832, 6951 (Canadian goldenrod)

**Sonchus asper* (L.) Hill, 5936, 5957 (spiny-leaf sow-thistle)

Symphyotrichum lateriflorum (L.) A. & D. Love, 6957, 6972 (American aster)

Symphyotrichum racemosum (Ell.) Nesom, 6999 (fragile-stem American aster)

Symphyotrichum subulatum (Michx.) Nesom, 6821, 6965 (seaside American aster)

**Taraxacum officinale* G.H. Weber ex Wiggers, 5960 (common dandelion)

Vernonia baldwinii Torr., 6798 (western ironweed)

Xanthium strumarium L., 6226, 6661, 6663 (cockleburr)

Azollaceae

Azolla caroliniana Willd., 5935 (Carolina mosquito fern)

Berberidaceae

**Nandina domestica* Thunb., 6465 (sacred-bamboo)

Bignoniaceae

Campsis radicans (L.) Seem. ex Bureau, 6179, 6652 (trumpet creeper)

Boraginaceae

**Heliotropium indicum* L., 6995, 8061 (Indian heliotrope)

Myosotis macrosperma Engelm., 6155, 6007, 7367 (large-seed forget-me-not)

Brassicaceae

**Brassica rapa* L., 5981 (rape)

**Capsella bursa-pastoris* (L.) Medik., 5939, 5958 (shepherd's purse)

Lepidium virginicum L., 6421 (poorman's-pepperwort)

Sibara virginica (L.) Rollins, 5938 (Virginia winged-rockcress)

Campanulaceae

Lobelia cardinalis L., 6989 (cardinal-flower)

Triodanis perfoliata (L.) Nieuwl., 6025, 6422 (clasping-leaf Venus'-looking-glass)

Caprifoliaceae

**Lonicera japonica* Thunb., 6192 (Japanese honeysuckle)
Sambucus nigra L., 6188, 6660 (black elder)

Caryophyllaceae

**Arenaria serpyllifolia* L., 6034 (thyme-leaf sandwort)
**Cerastium glomeratum* Thuill., 5940, 5964 (sticky mouse-ear chickweed)
Sagina decumbens (Ell.) T. & G., 5968, 6032 (trailing pearlwort)
**Stellaria media* (L.) Vill., 5965 (common chickweed)

Ceratophyllaceae

Ceratophyllum demersum L., 6956 (coon's-tail)

Commelinaceae

**Commelina communis* L., 6828 (Asiatic dayflower)
Commelina virginica L., 6824 (Virginia dayflower)

Convolvulaceae

**Convolvulus arvensis* L., 6651, 6765 (field bindweed)
Dichondra carolinensis Michx., 6005 (Carolina pony's-foot)
Ipomoea cordatotriloba Dennst., 6511, 6676 (tievine)
Ipomoea lacunosa L., 6816, 8062 (whitestar)

Cornaceae

Cornus drummondii C.A. Mey., 5998, 6512, 6760 (rough-leaf dogwood)

Cucurbitaceae

**Cucumis melo* L., 6808 (cantalope)

Cupressaceae

Juniperus virginiana L., 5979, 5989 (eastern red-cedar)
Taxodium distichum (L.) L.C. Rich., 6514 (cypress)

Cuscutaceae

Cuscuta gronovii Willd., 6815, 6961, 8042 (dodder)
Cuscuta indecora Choisy, 6807, 6841 (large-seed dodder)

Cyperaceae

Carex cherokeensis Schw., 6009, 6165 (Cherokee sedge)
Carex crus-corvi Schuttlew. ex Kunze, 6438 (raven-foot sedge)
Carex decomposita Muhl., 7429 (cypress-knee sedge)
Carex flaccosperma Dewey, 6184, 6217, 6008, 6162 (thin-fruit sedge)
Carex frankii Kunth, 6833 (Frank's sedge) [*C. aureolensis* Steud. FNA]
Carex leavenworthii Dewey, 6021, 6154 (Leavenworth's sedge)
Carex retroflexa Muehl. ex Willd., 6174 (reflexed sedge)
Cyperus acuminatus Torr. & Hook. ex Torr., 6450, 6492, 6636 (taper-tip flat sedge)
Cyperus croceus Vahl., 6492, 6630, 6671, 6677, 6834 (Baldwin's sedge)
**Cyperus difformis* L., 6993 (variable flat sedge)
Cyperus erythrorhizos Muhl., 6644 (red-foot flat sedge)
Cyperus esculentus L., 6857 (chufa)
Cyperus odoratus L., 6839, 6782, 6983 (rusty flat sedge)
**Cyperus rotundus* L., 6425 (purple flat sedge)
Eleocharis obtusa (Willd.) J.A. Schultes, 6448, 6515 (blunt spike-rush)
Eleocharis palustris (L.) Roemer & J.A. Schultes, 6231, 6429 (common spike-rush)
Fimbristylis autumnalis (L.) Roemer & J.A. Schultes, 6773 (slender fimbry)
Fimbristylis vahlii (Lam.) Link, 8040, 8066 (fimbry)
Fuirena simplex Vahl., 6673 (western umbella sedge)
Rhynchospora corniculata (Lam.) Gray, 6982 (short-bristle horned beak sedge)

Ebenaceae

Diospyros virginiana L., 6468, 6670 (common persimmon)

Equisetaceae

Equisetum hyemale L., 6003, 6487 (tall scouring-rush)

Euphorbiaceae

Acalypha rhomboidea Raf., 6800 (common three-seed-mercury)
Chamaesyce nutans (Laq.) Small, 6648, 6801, 6823, 6845, 6955 (eyebane)
Chamaesyce prostrata (Ait.) Small, 6958 (prostrate sandmat)
Croton capitatus Michx., 6687, 6817 (hogwort)
Croton glandulosus L., 6688 (vente-conmigo)
Croton monanthogynus Michx., 6763, 6846 (prairie-tea)
Euphorbia dentata Michx., 6844 (toothed spurge)
**Euphorbia helioscopia* L., 5961 (mad-woman's-milk)
Phyllanthus caroliniensis Walt., 6981 (Carolina leaf-flower)
**Sapium sebiferum* (L.) Roxb., 6196 (Chinese tallow)

Fabaceae

**Albizia julibrissin* Durazz., 6463 (silktree)
Amorpha fruticosa L., 6793, 7357 (false indigo-bush)
Cercis canadensis L., 6232 (redbud)
Desmanthus illinoensis (Michx.) MacM. ex B.L. Rob.& Fern., 6478 (prairie bundle-flower)
Desmodium canescens (L.) DC., 6827, 6766 (hoary tick-trefoil)
Gleditsia triacanthos L., 6186 (honey-locust)
Glottidium vescarium (Jacq.) Harper, 6775, 6822 (bagpod)
**Medicago arabica* (L.) Huds., 6176, 7359 (spotted medick)
**Medicago minima* L., 5978, 7640 (medick)
**Medicago lupulina* L., 5977 (medick)
**Medicago polymorpha* L., 6031 (tooth medick)
Mimosa strigillosa T. & G., 6420, 6657 (powderpuff)
Rhynchosia minima (L.) DC., 6809, 6859, 6991 (least snout-bean)
Sesbania herbacea (P. Mill.) McVaugh, 6855 (peatree)
Strophostyles helvula (L.) Ell., 6683, 6772 (trailing fuzzy-bean)
**Trifolium campestre* Schreb., 5988, 6030 (lesser hop clover)
**Trifolium pratense* L., 6187, 6466 (red clover)
**Trifolium repens* L., 6153, 7361 (white clover)
**Trifolium resupinatum* L., 6022 (reversed clover)
Vicia ludoviciana Nutt., 6177, 7364 (Louisiana vetch)
**Vicia sativa* L., 5962 (garden vetch)
**Vicia villosa* Roth, 6185 (winter vetch)

Fagaceae

Quercus nigra L., 5975 (water oak)
Quercus virginiana Mill., 5953 (live oak)

Gentianaceae
Centaurium muehlenbergii (Griseb.) W. Wright ex Piper, 6435 (Monterey centuary)
Sabatia campestris Nutt., 6495 (Texas-star)

Geraniaceae
Geranium carolinianum L., 5985, 7363 (Carolina crane's-bill)
**Geranium dissectum* L., 6159, 7362 (cut-leaf crane's-bill)

Hydrocharitaceae
**Hydrilla verticillata* (L.f.) Royle, 6513, 7464b (water-thyme)
Limnobium spongia (Bosc.) Steud., 7936, 7937 (frog's bit)

Iridaceae
Sisyrinchium rostulatum Bickn., 6227, 7370 (annual blue-eyed-grass)

Juglandaceae
Carya illinoinensis (Wangenh.) Koch, 6470 (pecan)

Juncaceae
Juncus bufonius L., 6445 (toad rush)
Juncus dichotomous Ell., 6182 (forked rush)
Juncus marginatus Rostk., 6432, 6493 (grass-leaf rush)

Lamiaceae
Hedeoma hispida Pursh, Burden s.n. (rough hedeoma)
**Lamium ampexicaule* L., 5937 (giraffehead)
**Lamium purpureum* L., 5967 (red henbit)
Salvia lyrata L., 6180 (lyer-leaf sage)
Stachys crenata Raf., 7647 (shade betony)
Teucrium canadense L., 6640 (American germander)

Lemnaceae
Lemna spp., 6234, 6861 (duckweed)
Spirodela sp., 6234, 6860 (duckmeat)
Wolffia sp., 6862 (watermeal)

Lentibulariaceae
Utricularia gibba L., 7181 (humped bladderwort)

Liliaceae
**Allium vineale* L., 6157 (crow garlic)
**Liriope muscari* (Dcne) Bailey, 6829 (big blue lilyturf)
**Narcissus* sp., 5955 (daffodil)
Nothoscordum bivalve (L.) Britt., 5943 (crowpoision)

Loganiaceae
Mitreola petiolata (Gmel.) Torr. & Gray, 6638, 6672, 6781, 6814 (lax hornpod)

Lythraceae
Ammania coccinea Rottb., 6788, 6789, 6997 (valley redstem)
Lythrum alatum Pursh, 6783 (wing-angle loosestrife)

Malvaceae
Hibiscus laevis All., 6641 (halberd-leaf rose-mallow)
Hibiscus moscheutos L., 6639 (crimson-eyed rose-mallow)
**Sida rhombifolia* L., 6647(tea weed)
Sida spinosa L., 6641, 6785 (prickly fanpetals)

Meliaceae
**Melia azedarach* L., 6183 (china-berry)

Menispermaceae
Cocculus carolinus (L.) DC., 6469, 6658, 6971 (Carolina coralbean)

Molluginaceae
**Mollugo verticillata* L., 6810, 8063 (green carpetweed)

Moraceae
Maclura pomifera (Raf.) Schneid., 6191 (bois d'arc)
**Morus alba* L., 5996, 6194, 7358 (white mulberry)
Morus rubra L., 6194 (red mulberry)

Myricaceae
Morella cerifera (L.) Small, 7041 (southern bayberry)

Nelmbonaceae
Nelumbo lutea (Willd.) Pers., 7428 (yellow-lotus)

Oleaceae
Forestiera acuminata (Michx.) Poir., 6214 (swamp-privit)
Fraxinus pennsylvanica Marsh., 6682 (green ash)
**Ligustrum sinense* Lour., 6166, 6650 (Chinese privit)

Onagraceae
Gaura mollis James, 6223 (velvetweed)
Ludwigia decurens Walt., 6790 (wing-leaf primose-willow)
Ludwigia leptocarpa (Nutt.) Hara., 6786, 6836, 8058 (angle-stem primose-willow)
Ludwigia peploides (Kunth) Raven, 6451 (floating primose-willow)
Ludwigia repens J.R. Forest., 6633 (creeping primose-willow)
Oenothera biennis L., 6794 (King's cureall)
Oenothera laciniata Hill., 5995, 6171, 7366 (cut-leaf evening-primrose)
Oenothera speciosa Nutt., 6434, 7365 (pinkladies)

Ophioglossaceae
Ophioglossum crotalophoroides Walt., 6026 (bulbous adder's-tongue)

Orchidaceae
Spiranthes laciniata (Small) Ames, 6500 (lace ladies-tresses)

Oxalidaceae
Oxalis corniculata L., 5947, 6656 (creeping yellow wood-sorrel)

Passifloraceae
Passiflora incarnata L., 6970 (purple passion-flower)

Phytolaccaceae
Phytolacca americana L., 6761 (pokeweed)

Pinaceae
Pinus taeda L., 5982 (loblolly pine)

Plantaginaceae
Plantago aristata Michx., 6494, 6509 (Mexican plantain)
Plantago heterophylla Nutt., 6023 (slender plantain)
Plantago virginica L., 5994 (pale-seed plantain)

Platanaceae
Platanus occidentalis L., 6002 (sycamore)

Poaceae
Andropogon glomeratus (Walt.) B.S.P., 6963 (bushy bluestem)
Andropogon virginicus L., 6996 (broom-sedge)
Aristida oligantha Michx., 6843, 7004 (prairie three-awn)
**Briza minor* L., 6172 (lesser quaking grass)

*_Bromus catharticus_ Vahl., 6190, 6028 (rescue grass)
*_Bromus japonicus_ Thunb. ex Murr., 6457 (Japanese brome)
Cenchrus spinifex Cav., 6504 (coastal sandburr)
*_Cynodon dactylon_ Pers., 6458, 6689 (Bermuda grass)
Dichanthelium aciculare (Desv. ex Poir.) Gould & Clark, 7652 (narrow-leaf panic grass)
Dichanthelium oligosanthes (Schult.) Gould, 6491 (manyflowered rosettegrass)
Digitaria ciliaris (Retz.) Koel., 6768, 6811 (southern crabgrass)
*_Digitaria ischaemum_ (Schreb.) Schreb. ex Muhl., 6962 (smooth crabgrass)
*_Echinochloa colona_ (L.) Link, 6646 (jungle-rice)
Echinochloa muricata (Beauv.) Fern., 6854 (rough barnyard grass)
Echinochloa walteri (Pursh) Heller, 6840
*_Eleusine indica_ (L.) Gaertn., 6770 (Indian goose grass)
Elymus virginicus L., 6156, 6655 (Virginia wild rye)
Eragrostis secundiflora J. Presl., 6631, 7005 (red love grass)
Festuca paradoxa Desv., 6193 (clustered fescue)
Leersia lenticularis Michx., 6959, 6976 (catchfly grass)
Leersia oryzoides (L.) Sw., 6967 (rice cutgrass)
Leersia virginica Willd., 6964 (white grass)
Leptochloa panicea (Retz) Ohwi, 6767 (needle spangletop)
Leptochloa panicoides (Presl.) Hitch., 6858 (Amazon spangletop)
*_Lolium perenne_ L., 6173 (perennial rye grass)
Panicum capillare L., 6820, 6840, 6994, 8060 (common panic grass)
Panicum dichotomiflorum Michx., 6680, 6966, 6842 (fall panic grass)
Panicum rigidulum Bosc. ex Nees, 6780, 6838 (red-top panic grass)
*_Paspalum dilatatum_ Poir., 6456 (golden crown grass)
Paspalum distichum L., 6635, 6856 (joint crown grass)
*_Paspalum notatum_ Fluegge, 6452, 6503, 6662, 8044 (Bahia grass)
Paspalum setaceum Michx., 6501, 6505 (slender crown grass)
*_Paspalum urvillei_ Steud., 6974 (Vasey's grass)
Phalaris caroliniana Walt., 6216, 6476 (May grass)
*_Poa annua_ L., 5984 (annual blue grass)
Setaria parviflora (Poir.) Kerguelen, 6769 (marsh bristle grass)
*_Setaria pumila_ (Poir.) Roemer & Schutes, 6418, 6973 (yellow bristle grass)
*_Sorghum halepense_ (L.) Pers., 6467 (Johnson grass)
Sphenopholis obtusata (Michx.) Scribn., 6497, 6498 (prairie wedgescale)
Triplasis purpurea (Walt.) Chapm., 6812, 6851 (purple sandgrass)
Tripsicum dactyloides (L.) L., 6979 (eastern mock grama)
*_Triticum aestivum_ L., 6485 (bread wheat)
Zizaniopsis miliacea (Michx.) Doell. & Asch., 6439, 6992 (marsh-millet)

Polygonaceae

Brunnichia ovata (Walt.) Shinners, 6681 (American buckwheatvine)
Polygonum hydropiperoides Michx., 6852 (swamp smartweed)
Polygonum scandens L., 6975 (climbing false buckwheat)
Polygonum setaceum Baldw., 6642 (bog smartweed)
Polygonum virginianum L., 6830 (jumpseed)
*_Rumex crispus_ L., 5959 (curly dock)
*_Rumex hastatulus_ Baldwin, 6017 (heart-wing sorrel)

Portulaceaceae

Portulaca oleracea L., 6784 (little-hogweed)

Potamogetonaceae

Potamogeton nodosus Poir., 6632, 6666 (long-leaf pondweed)

Primulaceae

Anagallis minima (L.) Krause, 6033 (chaffweed)
Samolus valerandi L., 6444 (seaside brookweed)

Ranunculaceae

Anemone berlandieri Pritz., 5954 (ten-petal thimbleweed)
Myosurus minimus L., 5974 (tiny mousetail)
*_Ranunculus muricatus_ L., 5948 (spring-fruit buttercup)
Ranunculus pusillus Poir., 6220 (low spearwort)
*_Ranunculus sardous_ Crantz, 5986, 6440, 7368 (hairy buttercup)

Rhamnaceae

Berchemia scandens (Hill) Koch, 5993, 6215 (Alabama supplejack)

Rosaceae

Crataegus spathulata Michx., 6181 (little-hip hawthorn)
*_Duchesnea indica_ (Andr.) Focke, 5952 (Indian strawberry)
Geum canadense Jacq., 6482 (white avens)
Prunus angustifolia Marsh., 5987 (Chickasaw plum)
*_Pyrus calleryana_ Dcne., 5976 (Bradford pear)
Rubus trivialis Michx., 5990 (southern dewberry)

Rubiaceae

Cephalanthus occidentalis L., 6637 (button bush)
Diodia teres Walt., 6686, 6813 (poorjoe)
Diodia virginiana L., 6446 (Virginia buttonwood)
Galium aparine L., 6016 (sticky-willy)
Galium tinctorium (L.) Scop., 6428 (stiff marsh bedstraw)
Houstonia micrantha (Shinners) Terrell, 5942, 5969 (southern bluet)
Houstonia pusilla Schoepf, 5941, 5971 (tiny bluet)
*_Sherardia arvensis_ L., 5949, 5963 (blue field-madder)
Spermacoce glabra Michx., 6668 (smooth false buttonweed)

Rutaceae

Zanthoxylum clava-herculis L., 6475 (Hercules'-club)

Salicaceae

Populus deltoides Bartr. ex Marsh., 6013, 6164 (cottonwood)
Salix exigua Nutt., 6665, 8043a, 8043b (narrow-leaf willow)
Salix nigra Marsh., 6000, 6020, 6168, 6474, 6479, 7959, 7960 (black willow)

Sapindaceae

Cardiospermum halicacabum L., 6776, 8065 (love-in-a-puff)

Saururaceae

Saururus cernuus L., 6490 (lizard's tail)

Scrophulariaceae

Agalinis heterophylla (Nutt.) Small ex Britt., 6805, 8059 (prairie false foxglove)

Leucospora multifida (Michx.) Nutt., 8041 (narrow-leaf conobea)

**Mazus pumilus* (Burm.f.) Steenis, 5983 (Japanese mazus)

Mecardonia acumnata (Walt.) Small, 6853 (axil-flower)

Mimulus alatus Ait., 6799 (sharp-wing monkey-flower)

Nuttallanthus texanus (Scheele) D.A. Sutton, 5992 (Texas toadflax)

**Veronica arvensis* L., 5970 (corn speedwell)

Veronica peregrina L., 5946, 5973, 7371 (neckweed)

**Veronica persica* Poir., 5966 (bird-eye speedwell)

Smilacaceae

Smilax bona-nox L., 6220, 6488 (Fringed Greenbrier)

Solanaceae

Physalis longifolia Nutt., 6653, 6667 (long-leaf ground-cherry)

Solanum carolinense L., 6419 (Carolina horse-nettle)

Solanum elaeagnifolium Cav., 6496 (silver-leaf nightshade)

Typhaceae

Typha latifolia L., 7451 (cat-tail)

Ulmaceae

Celtis laevigata Willd., 6163 (hackberry)

Ulmus alata Michx., 6218 (winged elm)

Ulmus americana L., 6001 (American elm)

Urticaceae

Boehmeria cylindrica (L.) Sw., 6797, 6968 (small-spike false nettle)

Valerianaceae

Valerianella radiata (L.) Dufr., 5991 (beaked cornsalad)

Verbenaceae

Phyla lanceolata (Michx.) Greene, 6473, 6960 (northern frogfruit)

**Verbena brasiliensis* Vell., 6471 (Brazilian vervain)

Verbena halei Small, 6423, 6804 (Texas vervain)

Verbena urticifolia L., 6792 (white vervain)

Violaceae

Viola bicolor Pursh, 5951 (field pansy)

Viola sororia Willd., 5950 (blue violet)

Viola sagittata Ait., 6006 (arrow-leaf violet)

Vitaceae

Ampelopsis arborea (L.) Koehne, 6477 (peppervine)

Ampelopsis cordata Michx., 6480, 6654 (heart-leaf peppervine)

Parthenocissus quinquefolia (L.) Planch., 6460 (Virginia-creeper)

Vitis riparia Michx., 6189, 6197, 6986, 5997 (river-bank grape)

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A FLORISTIC SURVEY OF VASCULAR PLANTS OVER PARTS OF NORTHEASTERN NEW MEXICO

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ABSTRACT

A floristic survey was completed in northeastern New Mexico, including all of Harding, Mora, and San Miguel counties, most of Colfax County, and Quay County north of Interstate 40. Prior to this study the approximately 41,000 km^2 (ca. 15,800 mi^2) study area, much of which is private land, had not been systemically surveyed for its plant diversity. A total of 9,619 specimens were collected during 2004 and 2005, which included 93 families, 437 genera, 911 species, and 956 taxa. *Rorippa teres*, *Chenopodium berlandieri* var. *berlandieri*, *Artemisia ludoviciana* var. *incompta*, *Tetraneuris torreyana* and *Rosa x harisonii* (escaped from cultilvation) were confirmed as state records. Approximately 9.3% of the flora (89 taxa) was non-native, including 11 species listed as "noxious" by the state of New Mexico. The collection methods, an overview of climate and geology, and discussion of vegetation types are included. The annotated checklist includes scientific names and authorities, total number of collections, counties represented with one voucher per county cited, habitat types, and elevational range for each taxon. Species accumulation curves for the five most frequently collected habitats suggest strongly that additional taxa will be found in each habitat. A Sørenson index was used to calculate floristic similarity of the Kiowa National Grasslands in New Mexico (within the study area) with that of the Pawnee and Comanche National Grasslands in Colorado. The first analysis, which included all plant taxa, indicated that the grasslands separated by the greatest distance had the least similarity. The second analysis, which excluded non-native taxa, increased the similarity values, which suggested that many exotic taxa are not shared between the three Grasslands.

RESUMEN

Un estudio florístico de las plantas vasculares que ocurren en el noreste de Nuevo México fue llevado a cabo en los condados de Colfax, Harding, Mora, Quay (al norte), y San Miguel durante las épocas de crecimiento en 2004 y 2005. Antes de este estudio esta área de 41,000 km^2 (15,000 mi^2) que es principalmente terreno privado, jamás había sido investigada en detalle para estimar la diversidad existente de las plantas vasculares. De las 9,619 muestras botánicas coleccionadas durante los dos años del estudio, se identificaron 93 familias, 437 géneros, 911 especies y 956 taxa. También el total se encontraron 89 plantas exóticas (no nativas), lo cual es aproximadamente 9.3% de la flora total. De estas colecciones se reportan *Rorippa teres*, *Chenopodium berlandieri* var. *berlandieri*, *Artemisia ludoviciana* var. *incompta*, *Tetraneuris torreyana*, y *Rosa × harisnoii* por primera vez para el estado de Nuevo México. Entre las plantas exóticas había 11 especies designadas para el estado de Nuevo México como malezas dañinas. Están incluidos los métodos del campo y datos del clima, geología, suelos y vegetación. Las cifras más detalladas de estas colecciones, con los números de colección, nombres científicos, autorías y los hábitats están incluidas. En los análisis de los datos se hicieron gráficas para cinco hábitats con el número de las especies identificadas en relación a las áreas estudiadas. Estas gráficas sugieren que todavía existen especies de plantas no colectadas en cada área. Se hicieron dos análisis del índice de Sørenson (un índice de semejanza) entre la diversidad de plantas en la Pradera Nacional del Kiowa en Nuevo México con las diversidades de plantas que ocurren en las praderas nacionales del Pawnee y del Comanche en Colorado. El primer análisis incluyó tanto las plantas nativas como las plantas exóticas de cada región. Como resultado, que cuanto más lejos un área fue ubicada de otra área, más bajo fue el índice de semejanza. El segundo análisis incluyó solamente las plantas nativas y con este análisis los índices de semejanza aumentaron. Este aumento del los índices de semejanza sugirió que hay plantas exóticas que ocurren en alguna, pero no en todas de las praderas estudiadas.

INTRODUCTION

The Rocky Mountains in the United States have been the site of over forty intensive floristic survey dating back to the early 1980s (e.g., Nelson 1984; Marriot 1985; Kastning 1990; Hartman 1992; Snow 1994–95; Hartman & Nelson 1998; Elliot 2000; Holt 2002; Reif 2006). Data from floristics projects are critical for determining emergent properties of taxa, such as assessing which are endangered or threatened, and habitat

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data provide important insights about how best to protect such species (Ertter 2000). Floristic studies also faciliate the tracking of vegetative change through time (Stein & Davis 2000), which is increasingly valuable given the extensive urbanization, overgrazing, and natural disasters (fire, flooding, diseases of forests) that have significantly changed much of the American landscape. Only floristics data can track the historical spread and relative abundance of non-native taxa, many of which are decreasing the commercial and private value of many lands (D'Antonio & Meyerson 2002). In addition, distributional data from floristic surveys can guide the restoration of degraded landscapes using native taxa (Stein & Davis 2000). Plant surveys may even be used in regional land planning (Neely et al. 2006) even though many counties in the United States have species lists that greatly underestimate the true number of plant taxa from those areas (Moerman & Estabrook 2006; Norris et al. 2001).

Comparing present and past plant distributions also allows biologists to evaluate the effects of long-term ecological changes. For example, the Floristic Quality Index (Northern Great Plains Floristic Quality Assessment Panel 2001) gives each plant species from a given area a value from 0 to 10 based on its ecological importance (Andreas et al. 2004). When plants from a specified area are viewed cumulatively, a value can be calculated that helps determine how the area should be ranked in terms of regional conservation priorities. As average global temperatures continue to increase and geographical distributions of species shift, floristic studies can be used to make informed decisions about the conservation of particular species.

Floristic surveys are particularly valuable because they summarize distributional data at relatively localized scales. An incomplete (and thus erroneous) knowledge of the distribution of a species can cause problems in the listing of plants as threatened or endangered in two ways. First, a species may be considered endangered erroneously due to limited knowledge of its true distribution and abundance. Expensive protective policies could be enacted unnecessarily due to formal listing on Endangered or Threatened lists, as well as causing unnecessary litigation (Ertter 2000). Second, a lack of (or limited) knowledge of taxonomic diversity, as for example how morphologically similar species are distinguished and how their distributions differ, may exclude taxa that need genuinely need protection (Ertter 2000). Given the large number of newly described plant taxa from North America over the past three decades, including many from New Mexico (Hartman & Nelson 1998), additional survey work is imperative if we expect to provide maximal protection for genuinely rare and threatened taxa.

The most important results of floristic studies, however, are the discovery of plant taxa new to science during intesive (Hartman & Kirpatrick 1986; Wilken & Hartman 1991; O'Kane & Reveal 2006) or routine collecting (Reveal 2002; Holmgren & Holmgren 2002). In light of such discoveries and the fact that large parts of North America (especially Canada and Alaska) have low collecting densities, the need for additional floristics work is clearly warranted in many areas.

New Mexico is one of the least explored states botanically in the United States, with perhaps only Nevada being less intensively surveyed overall among the mainland western states. Prior to this study, which was carried out primarily by the first author (Schiebout 2006), the High Plains region of northeastern New Mexico had been inadqueately surveyed. Evidence in support of this observation came from records in the database at the University of New Mexico, Albuquerque (UNM), which in late 2003 had accessioned and databased fewer than 900 total specimens from Union, Colfax, Harding and Quay counties (T. Lowrey, UNM herbarium curator, pers. comm. 2003). Although that figure now exceeds 3250 specimens (exclusive of specimens from this project), it still reflects a relatively low collection density for this expansive area.

The goal of this study was to document the floristic diversity of vascular plants from a large part of the northeastern counties of New Mexico. Two priorities were among the objectives. The first was to collect extensively on private lands, given that private holdings (generally cattle ranches) are among the least-collected portions of the western United States. This priority was deemed important becase most of the study area is privately held ranchland and because most ranches have one or more wetland areas that harbor plant taxa unique to those habitats. The second objective was to focus on aquatic and riparian habitats, which typically include taxa with narrow ecological distributions, and because aquatic and riparian habitats represent a small portion of the study area.

Boundaries of Study Area.—The study area is spread over a six-county area in northeastern New Mexico (Fig. 1) that we estimate encompasses approximately 41,000 km^2 (ca. 15,800 mi^2). It includes most of Colfax, Quay north of Interstate 40, and virtually all of Union, Harding, Mora, and San Miguel counties (Fig. 1). The survey area included elevations from 1100 to 2650 meters and focused mostly on the plains and foothills. The western boundary generally was the lower foothills of the Southern Rocky Mountains, although a few collections extended up to 2650 meters in Colfax County (Schiebout 2006; Table 2). A floristic study in progress that encompasses the headwaters and drainage of the Vermejo River and higher elevations of Colfax County and adjacent areas is in progress (B. Legler, pers. comm. 2008). The eastern boundary of the area was the Texas/Oklahoma border. The northern edge was the state of Colorado, whereas the southern boundary extended to approximately 35°15'N latitude (Fig. 1).

Geography and Geology.—The study area can be divided into three biogeographical regions: the high plains of New Mexico, encompassing the eastern half of the study area, the central plains of New Mexico, comprising the middle region of the study area, and the mountainous region occupying the western part of the study area (Dick-Peddie 1993). The high plains and the central plains together are part of the Southern Great Plains, whereas the mountainous region is on the east slope of the Sangre de Cristo Range of the southern Rocky Mountains (Chronic 1987).

Geologically, the study area is located east of the Rio Grande Rift. Moving east from the Rift towards Texas and Oklahoma, the landscape includes expansive plains, rolling hills, low bluffs and river valleys (Chronic 1987). Sedimentary rocks from the Permian and Miocene epochs are the most common in this area. Much of the surface region is covered with Permian limestone, part of the erosion-resistant San Andres limestone. Other common rocks in northeastern New Mexico include red Triassic sandstones and siltstones of the Chinle formation, and Dakota sandstone and Mancos shale formations from the Cretaceous period. Miocene-Pliocene gravel, part of the Ogallala formation, can also be found at the surface in many parts of northeastern New Mexico (Chronic 1987).

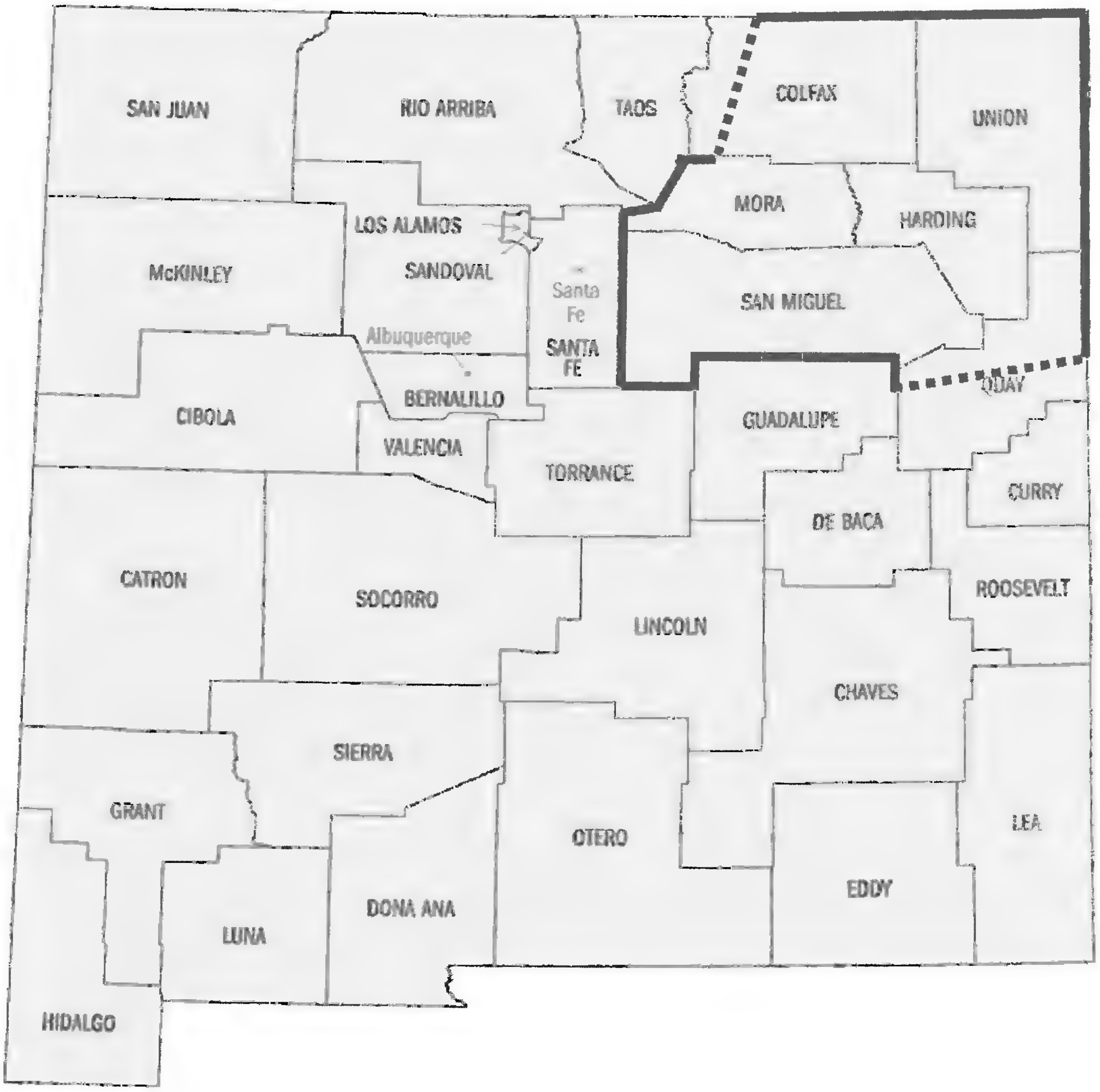
The study area contains relatively few prominent geological structures. However, faulting, folding, and some warping occur in the sedimentary layers. Much of the relief in the area was formed from the downcutting of the Canadian River and its tributaries. The Canadian River, which has its headwaters near Raton Pass in northern Colfax County, flows south through east-central New Mexico to the Conchas Reservoir in San Miguel County. Thereafter it flows east across the Texas Panhandle into Oklahoma. The river cuts a 300–400 meter deep gorge in Mills Canyon through the Tertiary and Mesozoic strata of the Las Vegas Plateau section of the Great Plains and the Canadian Escarpment (Wisniewski & Pazzaglia 2002), where the river divides Mora and Harding counties.

In the northern part of the study area, remnants of hundreds of small basaltic to nephelinitic volcanoes are found (U.S. Geologic Service 2006). Some of the more eroded volcanoes date to the Tertiary period, whereas the more recent ones are from the Pleistocene to Recent epochs (Chronic 1987). The newer volcanoes have experienced relatively little erosion. Volcanic activity of the more recent epochs left broad lava flows over large areas of northern Union and Colfax counties, some of which extend into southern Colorado.

Climate.—Climate varies relatively little throughout the study area. Annual precipitation ranges from 39.3–45.9 cm (Table 1). Precipitation increases slightly from southeast to northwest. This change is seen by comparing data from Cimmaron, Las Vegas, and Raton in the north to stations located in the eastern region, such as Conchas Dam and Clayton (Table 1).

The wettest months are July and August, when moisture from the Gulf of Mexico moves in a southeasterly circulation pattern (Rogash 2003). As the moisture-laden air ascends to higher elevations it condenses and falls as precipitation.

Temperatures likewise vary along a northwestern to southeastern gradient. The average annual maximum temperatures in the southeast average above 22.3°C, whereas annual maxima of 17.5–18.3°C occur in the northwest (Table 1). Elevation changes account for most of this variation, given the relatively small differences in latitude. In general, altitudes are highest in the northwest and lowest in the southeast. The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McKINLEY
Albuquerque
BERNALILLO
CIBOLA
VALENCIA
TORRANCE
GUADALUPE
QUAY
CURRY
DE BACA
CATRON
SOCORRO
LINCOLN
ROOSEVELT
CHAVES
SIERRA
GRANT
OTERO
LEA
EDDY
DONA ANA
LUNA
HIDALGO

Fig. 1. Outline of study area in northeastern New Mexico. Dashed lines indicate portions of the area with imprecise boundaries.

Table 1. Climatic data from 10 weather stations in northeastern New Mexico (Western Regional Climate Center 2006).

Location (Altitude in meters)	**Ave. Annual Max. Temp. (C) 1971–2000**	**Ave. Annual Min. Temp. (C) 1971–2000**	**Ave. Annual Total Precipitation (cm) 1971–2000**
AMISTAD (1376)	21.4	4.2	39.9
BELL RANCH (1372)	22.7	4.3	39.3
CIMARRON (1891)	18.3	0.6	45.9
CLAYTON (1512)	19.4	4.1	40.1
CONCHAS DAM (1294)	22.9	6.8	39.4
DES MOINES (2018)	17.5	2.1	45.8
LAS VEGAS (2013)	18.2	2.0	42.9
MOSQUERO (1665)	19.8	3.3	41.9
SPRINGER (1979)	20.2	0.6	43.1
RATON (1806)	18.1	-0.2	44.3

warmest months are July and August, whereas the coldest temperatures occur from December through March.

Vegetation Classification.—The study area is located predominantly within the North American Prairie Province, with portions of the western region within the Rocky Mountain Province (e.g., Takhtajan 1986). Ecologists have classified the area in several ways. The Rocky Mountain Province is sub-classified into the Intermountain Valleys and Lower Mountain Slopes, which include the Pinyon-Juniper Woodlands (West & Young 2000) and the Southern Rocky Mountains (Peet 2000). The North American Prairie Province is sub-classified into a number of major grassland types. Shortgrass prairie dominates the study area (Sims and Risser 2000). Dick-Peddie (1993) described seven land cover classes located in northeastern New Mexico, including coniferous and mixed woodland, plains mesa grassland, montane grassland, montane scrub, urban or farmland, subalpine coniferous forest, and juniper savanna. The classification of Dick-Peddie (1993) was followed broadly, but some additional categories were added for this project. The broad categories used to summarize distributions herein are grasslands, coniferous woodlands, wetlands, disturbed areas, and miscellaneous. Broad categories are subdivided as evident in Table 2.

METHODS

Plant collections were made at 249 sites across the study area during the late spring and summer during the relatively wet years of 2004 and 2005. In light of the large amount of privately held land in the study area, mostly cattle ranches, a concerted effort was made to collect on private lands. Efforts were made to focus on wetland areas (broadly construed) on the private properties. Eighteen landowners granted permission to collect from their properties, which resulted in 3012 specimens, or nearly one third of the total collections. Microsoft Access was used to generate lists of taxa collected from each private property, which have been sent to each landowner in gratitude for their cooperation and assistance.

Colleting permits were secured for the Kiowa National Grassland (FS-2700-5), nine New Mexico state parks (SU-05-06-ALL-02), and the Maxwell and the Las Vegas National Wildlife Refuges (22580-05-LV03 and 2005–01, respectively).

The general collecting procedure essentially followed Hartman (1992). In brief, entire days were spent collecting plants in flower or fruit from selected sites. Since most of the study area was located on the high plains, where the number of roads is generally adequate and remote mountainous areas absent, collections could be made more rapidly than for similar projects with greater amounts of mountainous terrain and fewer roads. Specimens sometimes were pressed the day of collection, but usually were placed on ice overnight and pressed the next day. Pressed specimens were dried immediately on portable wooden driers using 100-watt bulbs for two to four days. Over 150 days were devoted to collecting and pressing over two seasons. The 249 total collection sites were chosen to reflect the diversity of topography, geology, habitat types, and other factors, as well as locations on public or private lands. Unlike the procedure discussed by Hartman (1992), no attempt was made to collect based on predetermined criteria regarding the ideal number of collection points per linear mile. The first set of specimens is deposited at the University of Northern Colorado (GREE), along with photocopies of field notebooks. The largest number of duplicates resides at the University of New Mexico (UNM), and another large set was deposited at the Rocky Mountain Herbaruim at the University of Wyoming (RM).

References used most frequently for making identifications included: Flora North America Editorial Committee (1993+), Great Plains Flora Association (1986), Martin & Hutchins (1980, 1981), Ivey (2003), Diggs et al. (1999), Harrington (1964), Weber & Wittman (2001), Isely (1998) and Cronquist et al.(1972–1997). Cox (2001) was used to assist with identifications of non-native taxa in New Mexico. The non-native noxious plants of New Mexico were identified using USDA PLANTS (United States Department of Agriculture, Natural Resources Conservation Service 2006).

The initial nomenclatural authority for this project was Snow & Brasher (2004), which has been replaced by Snow (2007) each of which was based largely on the APGII classification (APG 2003; see also Stevens

Table 2. Vegetation types recognized for northeastern New Mexico for this study, indicating the number of sites visted for each type, the number of taxa collected overall from each type and its percentage of the total number of taxa, and elevational range for each habitat type. Sites included obvious ecotones, indicated as hyphenated combinations of two types (e.g. Lacustrine-Plains mesa grassland).

Vegetation Type	Sites	Taxa	% of Total Taxa	Elevation (M)
Grasslands				
Plains-Mesa grassland	82	434	44	1150–2500
Plains Mesa grassland-Pinyon-juniper woodland	3	125	13	1350–1700
Plains-Mesa grassland-Riparian	20	353	36	1350–1600
Plains-Mesa grassland-Rocky slopes	3	76	8	1150–1400
Montane grassland	1	4	0.4	2600–2650
Montane grassland-Lacustrine	1	123	12	2250–2300
Montane grassland-Riparian	2	136	14	2350–2600
Foothills grassland	2	78	8	1850–2000
Foothills grassland-Artificial impoundments	1	61	6	2000–2050
Coniferous woodlands				
Pinyon-juniper woodland	8	181	18	1450–1950
Pinyon-juniper woodland-Oak woodland	2	13	1	1950–2050
Pinyon-juniper woodland-Mixed shrubland	1	8	1	1600–1700
Pinyon-juniper woodland-Ponderosa pine woodland	2	47	5	1750–1950
Pinyon-juniper woodland-Rocky Wash	1	25	3	1750–1800
Ponderosa pine woodland	6	177	18	1200–2350
Ponderosa pine woodland-Riparian	3	122	12	1800–2350
Mixed coniferous woodland	1	26	3	2400–2450
Mixed coniferous woodland-Riparian	2	104	11	2250–2300
Deciduous woodlands				
Riparian woodland	3	116	12	1350–1450
Riparian woodland-Rocky Wash	1	93	9	1550–1600
Oak wood land	3	168	17	1550–2100
Oak wood land-Riparian	2	90	9	2350–2400
Shrublands				
Mixed shrubland	8	222	22	1250–2000
Mixed shrubland-Lacustrine	1	35	4	1750–1800
Wetlands				
Riparian	19	471	48	1100–2500
Riparian-Rocky Wash	2	93	9	1350–1400
Lacustrine	5	140	14	1800–2450
Lacustrine-Plains mesa grassland	2	56	6	1800–1850
Palustrine	2	29	3	1300–1900
Disturbed				
Artificial impoundments	9	240	24	1150–2050
Roadside	48	392	40	1150–2500
Miscellaneous				
Badlands	1	9	1	1150–1200
Rocky Wash	1	42	4	1500–1550
Rocky Slope	1	45	5	1350–1400

2001). Specimens that did not key out easily or match herbarium specimens particularly well were marked with “aff.” (affinities to). Species that may represent state records are prefixed with a number sign (#) in front of the taxonomic name.

Species accumulation curves were constructed for the five most frequently collected habitat types (plains mesa grassland, roadside, riparian, pinyon-juniper associates, plains mesa grassland-riparian) to assess the thoroughness of the sampling regime. Sequential visits to a habitat type are recorded on the x-axis. The cumulative number of species collected in each habitat type is recorded on the y-axis.

RESULTS

Over 9,600 specimens were collected, which include the following personal collection numbers: M. Schiebout (*117-2278, 2295-3113* and *3135-9151*); N. Snow (*9279-9526, 9564-9936*), and approximately 55 miscellaneous collections of D. Hazlett. Relatively small outliers of the Carson National Forest and Santa Fe National Forest occurring in the study area were bypassed, given recent floristic work on the Carson National Forest by Jill Larson (unpublished) and the Santa Fe National Forest by Reif (2006).

Vegetation types

To better understand the distribution of individual taxa, the study area was partitioned into a number of vegetation types (Table 2) and a record was made for each taxon of the vegetation types in which it was collected. The vegetation types, although necessarily somewhat arbitrary and broadly defined, none the less are useful to land use managers, ecologists, and other workers. They are described in the following paragraphs, including some of the more commonly encountered taxa in many.

Grasslands.—Plains Mesa Grassland is the most abundant type of grassland in New Mexico (Dick-Peddie 1993). It encompasses about two thirds of the study area, extending from the eastern border of New Mexico west to the foothills of the southern Rocky Mountains. As with other grasslands of central North America, it has a large representation of taxa from Poaceae and Asteraceae. A total of 82 collecting sites were made from Plains Mesa grassland, which yielded 434 taxa (Table 2). Some of the taxa collected most commonly included: *Aristida purperea* var. *longiseta, Bouteloua curtipendula, Bouteloua dactyloides, Bouteloua gracilis, Cheatopappa ericoides, Chenopodium incanum, Chenopodium pratericola, Cirsium ochrocentrum, Elymus elymoides* var. *brevifolius, Engelmannia pinnatifida, Glandularia bipinnatifida* var. *bipinnatifida, Guara coccinea, Hymenopappus filifolius* var. *polycephalus, Machaeranthera tanacetifolia, Psoralidium tenuiflorum, Ratibida columnifera, Solanum elaeagnifolium, Solanum rostratum, Sphaeralcea coccinea* var. *coccinea, Tetraneuris scaposa* var. *scaposa, Thelesperma megapotamicum, Xanthisma spinulosum* and *Zinnia grandiflora*.

Montane grasslands were designated to include areas above 2,000 m elevation. This type of grassland was rare, restricted to the western part of the study area, and generally was associated with wetland habitats. Montane grasslands yielded 4 taxa (Table 2).

Foothills grasslands are located up to 2,000 m; samples were collected from these sites only twice for this study, yielding 78 taxa (Table 2).

Coniferous Woodlands.—Pinyon-juniper woodlands are dominated by *Pinus edulis* and either (or both) *Juniperus scopulorum* and *J. monosperma*. The most abundant herbaceous species were *Berlandiera lyrata, Bouteloua dactyloides, Chaetopappa ericoides, Elymus elymoides* var. *brevifolius, Glandularia bipinnatifida* var. *bipinnatifida, Melampodium leucanthum, Oenothera albicaulis, Tetraneuris scaposa* var. *scaposa* and *Vulpia octoflora*. The 8 collection sites from this habitat yielded 181 taxa (Table 2).

Ponderosa pine woodland is dominated by *Pinus ponderosa*. Other types of vegetation often grew with the pine, frequently including species of oak (Dick-Peddie 1993). The most abundant native species were *Erigeron flagellaris, Hymenopappus polycephalus, Juniperus scopulorum, Koeleria macrantha, Pinus edulis, Poa pratensis, Quercus gambelii* and *Rhus aromatica* var. *trilobata*. Three introduced species commonly encountered were *Cynoglossum officinale, Dactylis glomerata* and *Melilotus officinalis*. The 6 collection sites from this habitat were represented by 177 taxa (Table 2).

Mixed coniferous woodland is a mixture of coniferous species including *Abies, Picea, Pinus* and *Pseudosuga*. This vegetation type occurs in the western and northern parts of the study area at elevations above approximately 2400 m. The single collection visit yielded 26 taxa (Table 2).

Deciduous Woodland.—Riparian woodland occurs on floodplains adjacent to watercourses. Species of *Salix* and *Populus* species dominated this vegetation type. The 3 collection sites from riparian woodlands yielded 116 taxa (Table 2).

Oak woodland forest or shrubland is dominated by *Quercus gambelii*, *Q. grisea* and/or *Q.* x *undulata*. The 3 collection sites from this vegetation type included 168 taxa (Table 2).

Shrubland.—Mixed shrubland consists of shrubs (and sometimes low-growing trees) and included species of *Quercus, Cercocarpus, Rhus* and *Artemisia*. The most abundant species were *Artemisia ludoviciana, Berlandiera lyrata, Juniperus monosperma, Quercus grisea, Quercus x undulata, Rhus aromatica* var. *trilobata, Senecio flaccidus* var. *douglassii, Solanum elaeagnifolium, Thelesperma megapotamicum* and *Zinnia grandiflora*. The 8 collection sites in this habitat yielded 222 taxa (Table 2).

Wetlands.—Riparian vegetation occurs in areas with seasonally saturated soils, or in sand or rocks adjacent to normal watercourses. The most abundant species were *Bromus japonicus, Eleocharis palustris, Elymus smithii, Equisetum laevigatum, Erigeron divergens* var. *divergens, Melilotus albus, Poa pratensis, Rhus aromatica* var. *trilobata, Shoenoplectus pungens* and *Tragopogon dubius*. The 19 collections made in riparian habitats yielded 471 taxa (Table 2).

Lacustrine areas occur along the margins of natural ponds or lakes. The most abundant species collected from this vegetation type were *Astragalus bisulcatus* var. *bisulcatus, Convolvulus arvensis, Chaetopappa ericoides, Eleocharis palustris, Erigeron canus, Erigeron colomexicanus, Glandularia bipinnatifida* var. *bipinnatifida, Linum lewisii* var. *lewisii, Melilotus officinalis, Poa pratensis, Taraxacum officinale* and *Tragopogon dubius*. The five collection sites from lacustrine areas included 140 taxa (Table 2).

Palustrine areas included wet meadows, marshes, groundwater springs or other natural areas of standing water. Two collection sites in paulustrine areas resulted in 29 taxa (Table 2).

Disturbed Areas.—Artificial impoundments included the margins of artificial ponds and reservoirs such as Clayton Lake, Ute Lake and Conchas Lake. The most abundant species collected from these sites were *Aegilops cylindrica* var. *cylindrica, Berlandiera lyrata, Calylophus hartweggii* subsp. *pubescens, Cirsium undulatum, Elymus elymoides* var. *brevifolius, Gaura parviflora, Glandularia bipinnatifida* var. *bipinnatifida, Melampodium leucanthum, Melilotus officinalis, Tamarix ramosissima, Tragopogon dubius, Xanthisma spinulosum* and *Zinnia grandiflora*. The nine collections sites at artificial impoundments yielded 240 taxa (Table 2).

Roadside habitat was designated mainly for areas between paved roads and their disturbed shoulders and adjacent fencelines. The most abundant species were *Chaetopappa ericoides, Convolvulus arvensis, Elymus elymoides* var. *brevifolius, Elymus smithii, Gaura coccinea, Glandularia bipinnatifida* var. *bipinnatifida, Lappula occidentalis* var. *cupulata, Linum lewisii* var. *lewisii, Machaeranthera tanacetifolia, Melilotus officinalis, Ratibida columnifera, Sphaeralcea coccinea* var. *coccinea, Tetraneuris scaposa* var. *scaposa, Tragopogon dubius* and *Xanthisma spinulosum*. A total of 48 collection sites from roadside habitats yielded 392 taxa (Table 2).

Miscellaneous Areas.—Badlands are highly eroded areas that have nutrient-poor soils and support relatively little plant life. Only 1 site, surrounded by Plains-Mesa grassland, was clearly of this type; it yielded 9 taxa (Table 2).

Rocky washes consist of rocky drainages where water flows only briefly in plains or foothills. The sole rocky wash habitat site yielded 42 taxa (Table 2).

Rocky slopes, as defined here, are rocky areas where no single vegetation type dominates. The 1 collection site from this habitat type which occurred in plains-mesa grassland, yielded 45 taxa (Table 2).

Numerical Summary of Vascular Plant Taxa Collected.—Figures reported here are tentative, and readers will note instances where we indicate that the initial determinations may be incorrect and need further study. The time and resources were not available to update tentative, initial identifications.

This study documented 93 families, 437 genera, 911 species (including those of hybrid origin), and 45 infraspecific taxa, for a total of 956 taxa of vascular plants (Table 3). The most species-rich families were Asteraceae, Poaceae, and Fabaceae (Table 4), which together accounted for ca. 40% of the taxa collected. The diversity for Amaranthaceae is higher than typically reported regionally (Taylor 2000; Arnett 2002; Reif 2006) because we followed APGII by including Chenopodiaceae in Amaranthaceae. Likewise, Plantaginaceae now includes many genera formerly included in Scrophulariaceae, most notably the species-rich genus *Penstemon*. Finally, Boraginaceae now includes species formerly included in Hydrophyllaceae, although the number of borage taxa overall are only minimally enlarged by taxa formerly in Hydrophyllaceae.

Table 3. Summary of taxa collected by higher taxonomic ranks from northeastern New Mexico.

	Families	Genera	Species and nothospecies	Infraspecific	Total Taxa
Fern Allies	2	2	5	0	5
Ferns	3	5	9	1	10
Gymnosperms	3	6	10	0	10
Angiosperms	85	424	887	44	931
Total	93	437	911	45	956

Table 4. Plant families in northeastern New Mexico with the greatest number of taxa.

Family	Number of Taxa	Percentage of Total Taxa
Asteraceae	184	19.2
Poaceae	128	13.4
Fabaceae	71	7.4
Brassicaceae	37	3.9
Rosaceae	31	3.2
Plantaginaceae	28	2.9
Cyperaceae	27	2.8
Amaranthaceae	27	2.8
Boranigaceae	25	2.6
Ranunculaceae	25	2.6

Table 5. Plant genera with the greatest representation in northeastern New Mexico.

Genus	Number of Species	Number of Taxa
Astragalus	17	17
Carex	16	16
Penstemon	16	16
Asclepias	13	13
Potentilla	11	11
Juncus	11	11
Erigeron	11	12
Chenopodium	10	11
Dalea	10	12
Solidago	10	10
Artimisia	9	12
Oenothera	9	11

Twelve genera were represented by 10 or more taxa, including (in decreasing order of abundance) *Astragalus*, *Carex*, *Penstemon*, *Asclepias*, *Potentilla*, *Juncus*, *Erigeron*, *Chenopodium*, *Dalea*, *Solidago*, *Artemisia*, and *Oenothera* (Table 5). These genera compare similarly to similar studies from nearby areas to the north (Taylor 2000; Arnett 2002), although *Dalea* and *Oenothera* are somewhat less common in other floristic studies from the Southern Rocky Mountians. *Dalea* becomes a more common floristic element in the Chihuahuan Desert to the south, and some taxa in the genus appear to be near their northernmost range at higher elevations in the study area.

Some taxa common to abundant relatively nearby to the north in Colorado appeared to be much less common in the study area. For example, *Elaeagnus angustifolia*, which is a noxious weed in Colorado, was not commonly encountered in the study area. *Cirsium arvense*, another noxious weed common in Colorado and elsewhere, was found only in isolated patches of disturbed areas.

Five taxa are confirmed as state records for New Mexico: *Rorippa teres*, *Chenopodium berlandieri* var. *berlandieri*, *Artemisia ludoviciana* var. *incompta*, *Tetraneuris torreyana* and *Rosa x harisonii*. The lattermost is a horticultural taxon escaped from cultivation. Six possible state records for New Mexico are reported but these require additional confirmation. Although a number of significant range extensions were noted for some taxa considered to be noxious weeds (Schiebout 2006), this paper does not address range extensions.

DISCUSSION

This project survey represents the first extensive floristic summary of the plant diversity occurring in this part of northeastern New Mexico based on focused field work and documented vouchers. Some specimens were difficult to identify with a high level of confidence irrespective of which references were used. This was partially due to the project having been carried out in a smaller herbarium and frequently having limited (or no) comparative material. *Mentzelia* and *Hymenopappus* include species that are not easily identified in this region given existing resources, nor did infraspecific key easily for *Heterotheca villosa*, *Aristida purpurea*, *Tetraneuris acaulis* and *Artemisia ludoviciana*.

No species listed as threatened or endangered were collected or observed during this study, which corroborates the perceived rarity of such taxa in the study region.

Approximately 275 taxa were collected only once, whereas approximately 115 were collected only twice. (Tentative figures are given because a few specimens remain indetermined). These numbers, along with the species accumulation curves (below), suggest strongly that further surveying is needed to fully document the plant taxa occurring in the area and in the various habitats. Additional collections from earlier in the flowering season (March and April) will likely yield additional records of native (e.g., *Leucocrinum montanum*, *Townsendia grandiflora*) and non-native (e.g., *Chorisora tenella, Ranunculus testiculatus*) specimens. Likewise, additional fieldwork in September and October likely would increase the number collections and diversity of taxa with late-summer flowering and fruiting schedules.

Species Accumulation Curves.—Species accumulation curves were analyzed for five habitat types to assess the thoroughness of the sampling regime (Fig. 2). The curves reflect the total number of taxa known from a habitat type as each habitat type site is visited sequentially. Species accumulation curves were calculated for plains mesa grassland, plains mesa grassland-riparian, riparian, pinyon juniper associates (including pinyon juniper woodland, pinyon juniper woodland oak woodland ecotone, pinyon juniper woodland mixed woodland ecotone, pinyon juniper woodland ponderosa pine woodland ecotone, pinyon juniper woodland rocky wash ecotone, plains mesa grassland and pinyon juniper woodland) and roadside collections.

A curve that leveled off towards the right as an increasing number of sites were collected within a habitat type would suggest that relatively few additional taxa would likely be recorded from a particular vegetation or habitat type with further collecting, and that the collecting regime was beginning to paint a fairly complete picture of diversity for a given habitat type. However, all of the curves reflected a steady upward trend when the study ended (Fig. 2). The rates of increase for plains mesa grassland and roadside areas were decidedly less than for the other three, which remained steep, and which suggest many more collections will be needed needed from these habitat types before the floristic diversity associated with each is well characterized. Although the curve associated with pinyon juniper associates flattened somewhat in its middle, the collection rate accelerated again in the latter collecting sites.

Table 6 reflects the average number of new taxa collected per site for five habitat types overall, during the first and second havles (respectively) of the total visitations to each habitat type. The two habitats with the greatest number of additional species per new site were the plains mesa grassland-riparian and riparian. In addition, the riparian habitat showed a greater increase in number of additional species per site visited for the second half of the collection episodes compared to the first half (Table 6). One probable partial explanation for this observation involves the late flowering periods of many Cyperaceae and Juncaceae, which are common in riparian areas. Another reason may be that relatively few habitats that generally support these families were visited during the first collection season. In general, all vegetation types indicated incomplete collecting (Fig. 2, Table 6). In particular, riparian vegetation appears to need the most additional attention for future collecting (Table 6).

Non-native and invasive taxa.—Non-native or invasive plant taxa were represented by 89 species, or approximately 9.3% of the taxa. The percentage of non-native taxa is presented for five of the most commonly encountered habitats (Table 7) shows that roadsides had the greatest percentage of non-natives at 11.7 percent. This result was expected given that roadsides are corridors for the spread of invasive plants. The figure of approximately 9.3% non-native taxa is slightly less than the figure of approximately 11% previously reported for New Mexico (Cox 2001), and compares similarly to other recent floristic studies from the southern Rocky Mountain area (Hazlett 2004; Arnett 2002). However, small towns and the disturbed habitats typically associated with them, such as vacant lots, were not targeted in this survey. Additional collecting in incorporated areas likely will yield additional records of non-native taxa.

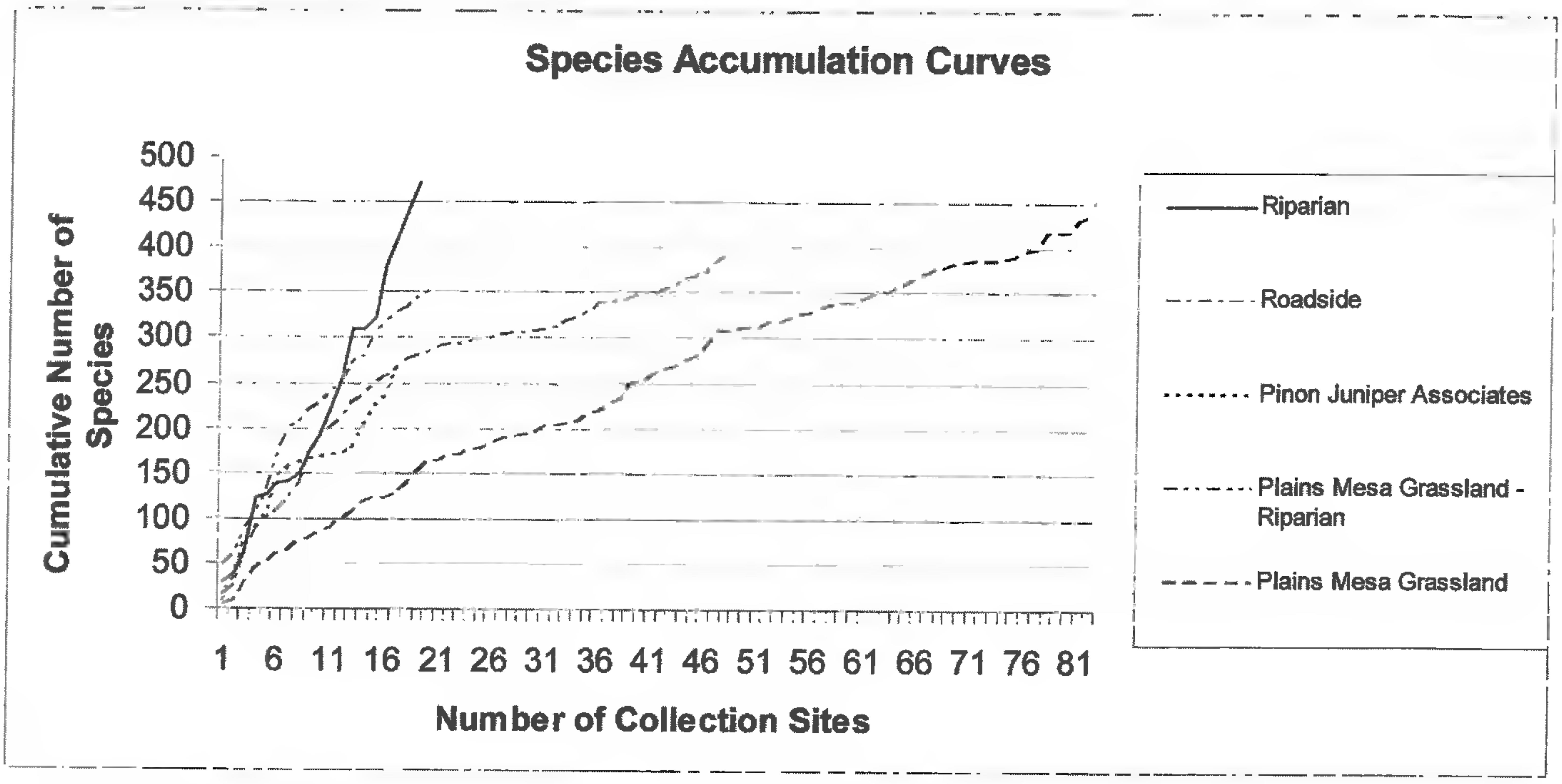

Fig. 2. Species accumulation curves for five of the most frequently collected habitat types.

Table 6. The average number of taxa collected for the first time during each successive visit for five habitat types. Total represents the number of taxa collected on average for the first time across all visits over two years. First Half represents the number taxa collected for the first time on average for the first half of the total number of visits; Second Half the same across the second half of all visits.

Habitat Type	Total	First Half	Second Half
Plains mesa grassland	5.3	6.3	4.3
Plains messa Grassland- Riparian	17.6	22.9	12.4
Pinyon juniper woodland- associates	15.5	20.2	11.2
Roadside	8.2	12.3	4.0
Riparian	24.8	19.1	29.9

Table 7. The percentage of non-native species collected across five habitat types.

Vegetation type	Collected Non-Native (%)
Plains Mesa Grassland	9.7
Pinyon Juniper Associates	9.9
Riparian	10.0
Roadside	11.7
Plains Mesa Grassland-Riparian	11.0

At the time of this study the State of New Mexico officially listed 35 taxa as invasive and noxious weeds (USDA 2006). Of these, 11 were collected in at least one county in the study area. Five were classified as Class C noxious plants: *Aegilops cylindrica, Convolvulus arvensis, Elaeagnus angustifolia, Tamarix ramosissima,* and *Ulmus pumila*. Class C species are widespread in New Mexico (DuBois 1999). Three were classified as Class B noxious plants: *Carduus nutans, Cirsium vulgare,* and *Conium maculatum*. Class B species are only located in certain portions of the state and should be treated as Class A plants in regions from which they are absent (DuBois 1999). Three were classified as Class A noxious plants: *Linaria dalmatica* subsp. *dalmatica, Cardaria draba,* and *Cirsium arvense*. Class A species are either absent from New Mexico or have a very limited distribution in the state (DuBois 1999).

Comparing the distribution of plants collected to the distribution maps located at the New Mexico State Weed Information Web Site (NMSU 2005), five species included new county records. The range of *Aegilops cylindrica* now includes Colfax, Mora and Union Counties; that of *Lepidium draba* and *Cirsium vulgare* now include Mora County; that of *Linaria dalmatica* subsp. *dalmatica* now includes Colfax County; and the range of *Ulmus pumila* now includes Mora County (Table 8).

Species of Special Concern.—Few plant taxa in northeastern New Mexico are federally listed as threatened or endangered. From the six county study area only 10 species are designated as rare by the New

Table 8. Declared noxious weeds collected from the study area, country distribution in study area, and New Mexico state weed status (New Mexico State University Weed Information 2005).

Scientific Name	County Distribution in Study Area	State Weed Status
Aegilops cylindrica	Colfax, Mora, San Miguel, Union	C
Carduus nutans	Colfax, Mora, , San Miguel	B
Cirsium arvense	Colfax	A
Cirsium vulgare	Colfax, Mora	B
Conium maculatum	Colfax	B
Convolvulus arvensis	Colfax, Harding, Mora, San Miguel, Union	C
Elaeagnus angustifolia	San Miguel, Quay	C
Lepidium draba	Mora, San Miguel, Union	B
Linaria dalmatica subsp. *dalmatica*	Colfax	A
Tamarix ramosissima	Colfax, Harding, Mora, San Miguel, Quay, Union	C
Ulmus pumila	Mora, San Migel, Union	C

Mexico Rare Plant Technical Council (1999; Tables 9 and 10). Of these, one collection was made of *Astragalus wittmannii*. Three other species were collected that are being monitored by the New Mexico Natural Heritage program include *Euphorbia strictior*, *Astragalus shortianus*, and *Penstemon auriberbis*.

Floristic Comparisons.—Taxa from the Kiowa National Grassland portion of this survey were compared to the published results of the Comanche (Hazlett 2004) and Pawnee National Grasslands (Hazlett 1998). The Pawnee is located in northeastern Colorado, whereas the Comanche Grassland is in southeastern Colorado. These locations were chosen for comparison because they are similar ecosystem types (shortgrass prairie) with similar elevations along a latitudinal gradient with nearly the same longitude. The Pawnee Grassland is located between 40°36' and 41°00' latitude. The Comanche Grassland is located between 37°00' and 38°00' latitude. The Kiowa Grassland is located between 35°45' and 36°45' latitude. A Sørensen's Similarity Index was used to determine floristic similarities between the three grasslands (Sørensen 1948).

Similarity between two areas is expressed by the quotient of similarity (qs), wherein (qs) = 2 (C) / A + B, where A = the number of species of sample A, B = the number of species of sample B, and C = the number of species common to both A and B (Barbour et al. 1987). This formula provides a measure of taxa in common between two areas, but does not account for relative abundance of species. The higher the value of qs, the greater the number of shared taxa between the two areas.

In addition to one analysis that included all taxa, a second analysis compared areas after the non-native taxa had been removed from the data. Including the second analysis is of considerable interest in light of current needs, particularly at the State level, to monitor and control the spread of noxious plant species. Evaluating the relative abundance of non-native plants in this manner may provide insights into the control of invasive species (Pysek et al. 2005).

The results indicate a clear latitudinal variation in species distributions (Table 11). The closer the locations are to each other the more taxa they share. For example, the relatively adjacent Pawnee and Kiowa have an Index of Similarity of 0.46, whereas that for the relatively distant Kiowa and Comanche is 0.62 (Table 11). The similarity of the Pawnee and Comanche is 0.51, a value intermediate between the Grasslands separated by the greatest distance (Table 11).

Given that many invasive species have extensive distributions in North America and that relatively few barriers exist to plant migration on the plains, similarity values that exclude non-native taxa may portray the floristic similarities more accurately exclusive of anthropogenic effects. For example, the inclusion of exotic species may artificially inflate the similarity between the Kiowa and Pawnee, since their exclusion leads to a lower similarity value (Table 12). However, irrespective of whether exotic species were included (Table 11) or excluded (Table 12), grasslands were always more similar to one another than those further apart (Kiowa with Pawnee).

An unexpected result was obtained for the Kiowa and Comanche Grasslands when exotic species were

Table 9. Plant species considered rare from counties in the study area. Only *Astragalus wittmannii* and *Grindelia acutifolia* were observed in the field (New Mexico Rare Pant Council 1999).

Taxa	**County Distribution**
Astragalus wittmannii	Colfax, Harding, Mora
Calochortus gunnisonii var. *perpulcher*	Colfax, Mora, San Miguel
Delphinium robustum	Colfax, Rio Arriba, Sandoval, Taos
Delphinium sapellonis	Bernalillo, Los Alamos, Mora, San Miguel, Sandoval, Santa Fe
Erigeron subglaber	San Miguel, Taos
Eriogonum aliquantum	Colfax
Grindelia acutifolia	Colfax
Hackelia hirsuta	Colfax, Mora, Rio Arriba, San Miguel, Santa Fe, Taos
Ipomopsis sancti-spiritus	San Miguel
Packera spellenbergii	Harding, Union
Salix arizonica	Mora, Rio Arriba, Taos

Table 10. Rankings of plant species considered rare from the study area by different state and federal organizations (New Mexico Rare Pant Council 1999).

Taxon	**USFWS**	**State of NM**	**USFS**	**Natural Heritage NM**	**Global Rank**
Astragalus wittmannii	SoC	SoC	Sen	S3	G3
Calochortus gunnisonii var. perpulcher	SoC	SoC	Sen	S4?	G5T4?
Delphinium robustum	SoC	SoC	Sen	S4?	G5T4?
Delphinium sapellonis	SoC	SoC	Sen	S?	G2?
Erigeron subglaber	SoC	SoC	Sen	S3	G3
Eriogonum aliquantum	SoC	SoC		S3	G3
Grindelia acutifolia	SoC	SoC		S2	G2
Hackelia hirsuta	SoC	SoC		S?	G4?
Ipomopsis sancti-spiritus	E	E	E	S1	G1
Packera spellenbergii	SoC	SoC	Sen	S2	G2?
Salix arizonica	SoC	SoC	Sen	S1	G2G3

Table 11. Sørensen's Floristic Similarity Index for three federal grasslands including all taxa collected from each site. Bold, underlined diagonal numbers are the number of taxa found on each of the grasslands. Bold numbers above the diagonal numbers are the number of taxa in common between the areas. Normal font numbers below the diagonal are Sørensen's Floristic Index of Similarity.

	Kiowa Grassland	**Comanche Grassland**	**Pawnee Grassland**
Kiowa Grassland	**448**	300	223
Comanche Grassland	0.62	**513**	263
Pawnee Grassland	0.46	0.51	**521**

Table 12. Sørensen's Floristic Similarity Index for three federal grasslands including only the native taxa from each site. Bold, underlined diagonal numbers are the number of native taxa found on each of the grasslands. Bold numbers above the diagonal numbers are number of native taxa in common between the areas. Normal font numbers below the diagonal are Sørensen's Floristic Similarity Index.

	Kiowa Grassland	**Comanche Grassland**	**Pawnee Grassland**
Kiowa Grassland	**397**	256	166
Comanche Grassland	0.65	**387**	207
Pawnee Grassland	0.41	0.52	**406**

removed (Table 12). In this case the similarity index increased with the removal of exotic species. A potential explanation for this result could be that some exotic species may be restricted to specific habitat types associated with just one of the Grasslands. For example, the Canadian River basin may support unique non-native taxa because of its riparian habitat. Unknown edaphic, climatic, or biogeographic barriers may also prevent exotic species from moving farther north into the Comanche Grassland, or likewise from moving farther south from the north into the Kiowa Grassland. The same result was obtained between the Pawnee and Comanche Grasslands when non-native taxa were excluded, although the increase in similarity index was only 0.01.

CONCLUSIONS

This floristic study has been the first to systemically inventory a large part of northeastern New Mexico that focused particularly on the plains and mesas. Despite securing over 9,600 specimens, the average collection density for the area is still not particularly high. We have not attempted to accurately estimate the collection density given the many recent collections from northern New Mexico by colleagues (mostly) at the University of Wyoming, some of which overlap (especially in Colfax County) this study area. Despite the limited coverage in many areas, we estimate this proejct has documented in excess of 90% of the taxa present in the study area. A priority to focus much of the collecting on privately held lands was acheived, although each property typically was visited only once or a few times. We believe that much more field work will be needed to fully characterize the plant diversity of northeastern New Mexico and that future collecting should continue to focus on prviately held lands and riparian areas, both of which will reveal many new records.

ANNOTATED CHECKLIST

The annotated checklist that follows summarizes information about each plant taxon collected from the study region. It also includes a few taxa known from the area but not collected in this study (e.g., *Packera spellenbergii*). Abbreviations used in the annotated list follow immediately below. Nomenclatural authorities generally follow Snow (2007). In light of widespread acceptance of alternative names for some taxa, the most commonly used synonym is sometimes included in brackets following details of the species. However, some generic changes are so commonly accepted (e.g., *Physaria* instead of *Lesquerella*) that synonomys for these taxa have not been included.

Arrangement of information in the Annotated Checklist for each taxon.—*Latin binomial* (with infraspecific taxa, if appropriate) Authority: total number of collections; county (voucher number with collector [no initials prior to number = Michael Schiebout; NS = Neil Snow, DH = Donald Hazlett, BR = Brian Reif]); vegetation types; elevation range in meters.

Key to symbols prefixing some taxa

SR = state record
# = potential state record
! = non-native (Cox 2001)
!! = non-native noxious (USDA, NRCS 2006)
***** = affinity towards a particular species
? = affinity at the infraspecific level
~ = species tracked by New Mexico Natural Heritage Program
& = known from study area but not collected

County abbreviations
CO = Colfax
HA = Harding
MO = Mora
QU = Quay
SM = San Miguel
UN = Union

Abbreviations for Vegetation Types

mog = montane grassland
fog = foothills grassland
pjw = pinyon-juniper woodland
ppw = ponderosa pine woodland
mcw = mixed coniferous woodland
riw = riparian woodland
oaw = oak wood land
mxs = mixed shrubland
rip = riparian
lac = lacustrine
pal = palustrine
ari = artificial impoundments
rds = roadside
bdl = badlands
rsl = rocky slope
row = rocky wash

FERN ALLIES

Equisetaceae

Equisetum arvense L.: 6; CO (6723), MO (4729); rip-ppw, rip, mog-rip, rip-ppw; 1800–2600 m.

Equisetum laevigatum A. Braun: 34; CO (6724), HA (6579), MO (4723), SM (6169), UN (6807); rip-ppw, oaw-rip, ppw, rip, mog-rip, rip-pmg, pmg, rds, oaw, ari; 1400–2400 m.

Selaginellaceae

Selaginella densa Rydb.: 7; HA (3057), SM (8905) UN (5166 B); mxs, pjw-row, mcw-rip, rip-pmg; 1500–1900 m.

Selaginella mutica D. C. Eaton ex Underw. var. *mutica*: 3; HA (DH-12118), SM (8904); mxs, rip; 1,600–1900 m.

Selaginella underwoodii Hieron.: 4; HA (5449) UN (8694); rip, mcw-rip, pmg-rip, row-rip: 1350–1750m.

FERNS

Aspleniaceae

Asplenium septentrionale (L.) Hoffm.: 1; HA (DH-11716); 1750–1800 m.

Dryopteridaceae

Cystopteris fragilis (L.) Bernh.: 2; CO (6655); rip, mcw; 2400–2450 m.

Woodsia neomexicana Windham: 1; HA (1333-A); pjw-row; 1750–1800 m.

Woodsia oregana D. C. Eaton subsp. *cathcartiana* (B. L. Rob.) Windham: 3; HA (458), UN (3235); ari, ppw-pjw, pmg-rip; 1500–1750 m.

**Woodsia* aff. *oregana* D. C. Eaton subsp. *cathcartiana* (B. L. Rob.) Windham: 1; UN (5165); mcw-rip (on basalt).

Pteridaceae

Astrolepis cochisensis (Goodding) Benham & Windham subsp. *cochiensis*: 1; SM (4788); oaw; 1950–2000 m.

Cheilanthes eatonii Baker: 6; HA (3053), MO (DH-12183), SM (8868), UN (3233); pjw-row, mxs, ari, rip, rsl; 1500–1850 m.

Cheilanthes feei T. Moore: 4; HA (457), MO (DH-12181), UN (5164); ppw-pjw, mcw-rip, rip-row, rsl; 1250–1750 m.

Cheilanthes fendleri Hook.: 3; HA (5448), SM (3713) ; rip, pjw-row, pjw; 1700–1950 m.

Notholaena standleyi Maxon: 3 SM (4838), UN (2483); mxs, rip-row, rip; 1350–1850 m.

Pellaea atropurpurea L.: 1, MO (DH-12180); row, 1500–1600 m.

GYMNOSPERMS

Cupressaceae

Juniperus communis L. var. *depressa* Pursh: 2; CO (4697); rip-ppw, rip; 1800–2450 m.

Juniperus monosperma (Engelm.) Sarg.: 38; HA (4409), MO (487), QU (3681), SM, (6078) UN (5804); pmg-pjw, rip, mxs, pmg, ppw-pjw, pjw-row, mxs-lac, ppw, ari, oaw, rds, pjw, riw, rsl, rip-pmg, rip-row; 1100–2200 m.

Juniperus scopulorum Sarg.: 39; CO (6721) HA (8435) MO (6244) SM (8953) UN (5179); rip-ppw, ppw, rip, rds, mcw, ppw-pjw, fog-ari, pjw, rip-oaw, oaw, rip-pmg, fog, pmg, rip-row, rds-riw, ari, pjw-pmg; 1550–2450 m.

Ephedraceae

Ephedra torreyana S. Watson: 4; QU (4493), SM (6083); ari, mxs, pmg, ppw; 1150–1350 m.

Pinaceae

Abies concolor (Gord. & Glend.) Hildebr.: 2; CO (4715); rip-ppw, mog-rip; 1800–2600 m.

Picea engelmannii Parry ex Engelm. var. *engelmannii*: 1; CO (9126); mog-rip; 2550–2600 m.

Picea pungens Engelm.: 2; CO (6676), MO (3361); rip; 2400–2500 m.

Pinus edulis Engelm.: 28; CO (6743), HA (468), MO (3158), SM (4820), UN (5754); rip-ppw, rip, ppw, ppw-pjw, pjw-row, mxs, mxs-lac, rip-row, pjw, riw, mcw-rip, rsl, pmg,-pjw, rsl-riv; 1450–2350 m.

Pinus ponderosa Douglas ex P. & C. Lawson var. *scopulorum* Engelm.: 24; CO (5320), HA (5458), MO (4752), SM (3741), UN (5174); oaw-rip, mcw-rip, rip-ppw, rip, ppw, mcw, rip, pjw, pjw-row, ppw-pjw, mxs-lac, rip-pmg, mog-rip, lac; 1550–2450 m.

Pseudotsuga menziesii (Mirb.) Franco var. *glauca* (Beissn.) Franco: 7; CO (5319), MO (4767), UN (5175); oaw-rip, mog-lac, ppw, mcw, lac, rip-ppw, mcw-rip; 2250–2450 m.

ANGIOSPERMS

Adoxaceae

Sambucus racemosa L. var. *microbotrys* (Rydb.) Kearn. & Peeb. : 2; CO (6671); rip, mcw-rip; 2250–2450 m.

Agavaceae

Leucocrinum montanum Nutt. ex A. Gray: 1; UN (4218); rip-oaw; 1900–1950 m.

Yucca baccata Torr. var. *baccata*: 5; CO (7932), HA (DH-12146), MO (6376), SM (8906); rip, ppw, rip-ppw, mxs; 1550–2350 m.

* *Yucca* aff. *elata* Engelm.: 4; HA (4975), SM (4849); rip, pmg, rds; 1300–1400 m. According to one of the reviewers, "*Y. elata* does not occur north of Lincoln Co. in eastern NM. The paniculate, accaulescent or short-stemmed yuccas of northeastern NM have been variously treated as variants of *Y. glauca*, *Y. intermedia* var. *ramosa*, and introgressive hybrids involving various taxa including *Y. elata*. None of these are concepts have strong support. This section of the genus has poorly resolved species boundaries, but yuccas in this study area are not known to fall in the accepted circumscription of *Y. elata*".

Yucca glauca Nutt. var. *glauca*: 23; CO (6513), HA (5005), MO (2259), QU (4460), SM (6035), UN (5608); ppw, mxs, pmg, rip, pmg-pjw, pjw, rds, ari, pmg-rip, riw, row, rsl-riv; 1150–2350 m.

Yucca neomexicana Wooton & Standl.: 1; SM (7093); ari; 2000–2050 m.

Alismataceae

Alisma gramineum Lej.: 1; CO (9025); lac; 1800–1850 m.

Sagittaria cuneata E. Sheld.: 2; UN (8038); oaw, ari; 1550–1600 m.

Sagittaria latifolia Willd.: 1; MO (DH-12107); 1500–1600 m.

Alliaceae

Allium cernuum Roth: 9; CO (8766), MO (8812), SM (8929), UN (1127); rds, rip, mog-lac, mog-rip, fog-ari, oaw, fog; 1550–2600 m.

Allium drummondii Regel: 4; MO (6394), QU (NS-9804), UN (3581); pmg, rip-ppw, rip-pmg; 1400–2350 m.

Allium geyeri S. Watson var. *geyeri*: 4; CO (5227) UN (5147); mcw-rip, ppw; 2250–2350 m.

Allium geyeri S. Watson var. *tenerum* M. E. Jones: 1; CO (5305); oaw-rip; 2350–2400 m.

Allium perdulce S. V. Fraser var. *perdulce*: 14; HA (5840), MO (4557), QU (3664), SM (3921), UN (3172); pmg, rip-pmg, pmg-pjw, mxs-lac, rds, ari, pjw; 1250–1750 m.

Amaranthaceae

! *Amaranthus albus* L.: 1; UN (1531), pmg, 1500–1550 m.

Amaranthus arenicola I. M. Johnst.: 7; HA (8258), UN (7625), pmg, pmg-rip; 1300–1550 m. Most collections were from sandy soils.

! *Amaranthus blitoides* S. Watson: 1; HA (7762); pjw; 1750–1800 m.

! *Amaranthus hybridus* L.: 6; CO (8999), MO (8585), SM (8940), UN (7998); lac, rip, fog-ari, pmg-rip, oaw; pmg; 1400–2050 m.

Amaranthus palmeri S. Watson: 6; HA (7282),UN (7720); rip-pmg, pmg, rip-row; 1350–1500 m.

! *Amaranthus retroflexus* L.: 2; UN (2604); pmg; 1400–1550 m. One collection was made on lava substrate.

Atriplex argentea Nutt. var. *argentea*: 1; HA (4356); rip-pmg; 1350–1400 m.

Atriplex canescens (Pursh) Nutt. var. *canescens*: 18; CO (6790), HA (6592), MO (3166), SM (3928), UN (1160); rds, lac, pmg, ari, ppw, pmg-lac, rip, rip-row, pjw, fog, rda-rip, rsl, rsl-riv; 1350–1650 m.

! *Chenopodium album* L.: 28; CO (8991), HA (8306), MO (8494), SM (7044), UN (6863); lac, ppw, mog-rip, rip, rip-pmg, rip-ppw, rds, ari, fog-ari, riw, pmg, oaw, fog, pmg; 1350–2350 m.

* *Chenopodium* aff. *album* L.: 3; UN (1650) CO (5511), HA (717); rds, pmg; 1650–1950 m.

SR ! *Chenopodium berlandieri* Moq. var. *berlandieri*: 1; UN (2605 B); pmg; 1500–1550 m. Collected on lava substrate. All indications (Kartesz, pers. comm., 2008 ; Allred 2005, 2006; FNA 4: 294) confirm this as a state record.

Chenopodium berlandieri Moq. var. *zschackei* (Murray) Murr. ex Asch.: 8; CO (8987), HA (7195), UN (2649); lac, rds, pmg, ari, rds-rip; 1400–2500 m.

!* *Chenopodium* aff. *capitatum* (L.) Asch.: 1; SM (7034); ari; 2000–2050 m.

Chenopodium desiccatum A. Nelson: 17; HA (714), SM (8926 A), UN (241); pmg, fog-ari, ari, rip-pmg, rip; 1350–2050 m.

* *Chenopodium* aff. *desiccatum* A. Nelson: 1; CO (8718); rds; 2450–2500 m.

Chenopodium fremontii S. Watson: 3; HA (1335), MO (6406 A), UN (1170); fog, rip-ppw, pjw-row; 1750–2350 m.

* *Chenopodium* aff. *fremontii* S. Watson: 3; CO (6668), HA (514), UN (5176); rip, pjw, mcw-rip; 1550–2450 m.

! *Chenopodium glaucum* L. var. *glaucum*: 1; SM (7035 A); ari; 2000–2050 m.

!* *Chenopodium* aff. *glaucum*. L. var. *glaucum*: 1; CO (8986); lac; 1800–1850 m.

Chenopodium incanum (S. Watson) A. Heller var. *incanum*: 45; HA (4358), SM (5935), UN (952); rip-pmg, rip, pmg, pjw, mxs, row, fog, rds, pmg-pjw, pmg-pjw; 1150–1850 m.

Chenopodium leptophyllum (Moq.) Nutt. ex S. Watson: 10; HA (6593), MO (7816), QU (2698), UN (7702); rip, pjw, rip-pmg, pmg, rds; 1300–1800 m.

Chenopodium neomexicanum Standley: 1; MO (8829); rip; 2450–2500 m.

Chenopodium pratericola Rydb.: 51; CO (7157), HA (4933), MO (507) SM (2302), UN (7336); rip-pmg, ari, mog-rip, rds, pmg, rip, mxs, riw, row; 1300–2600 m. [= *C. pratericola* Rybd.]

* *Chenopodium* aff. *pratericola* Rydb.: 1; HA (5043); pmg; 1250–1300 m. [=*C.*

Chenopodium simplex (Torr.) Raf.: 4; CO (7508), MO (8493), UN (2072); mog-lac, rip, rip-pmg; 1300–2300 m.

* *Chenopodium* aff. *simplex* (Torr.) Raf.: 2; CO (5338), MO (2264); lac, rds; 1800–1950 m.

Cycloloma atriplicifolium (Spreng.) J. M. Coult.: 2; HA (8311), UN (2969); pmg; 1300–1500 m. Specimen collected from sandy soil.

Froelichia gracilis (Hook.) Moq.: 13; HA (3041), MO (8513), UN (960); mxs, rip, pmg, pmg-pjw, rip-row; 1400–1600 m.

! *Kochia scoparia* (L.) Schrad.: 16; CO (7165), HA (7295), MO (2256), SM (8119), UN (7967); ari, lac, rip-pmg, pmg, rds, oaw; 1350–2000 m.

Krascheninnikovia lanata (Pursh) Meeuse & Smit: 10; CO (6498), HA (7225), SM (8125), UN (1651); ppw, pmg, rip-pmg, rip, pmg-rip, ari, pmg-pjw, rsl, rds; 1350–2050 m.

Monolepis nuttalliana (Schult.) Greene: 1; HA (4625); pmg-lac; 1800–1850 m. Specimen was collected from sandy soil.

! *Salsola australis* R. Br. 45; HA (7223), MO (8583), QU (2702), SM (8189), UN (7385); pmg, rip-pmg, pjw, rip, mxs, rds, fog-ari, ari, row, pmg-rsl, rip-row; 1150–2050 m. [= *Salsoa tragus* L.]

! *Salsola collina* Pall.: 2; HA (522), MO (DH-12187); pjw, rip; 1550–1650 m.

Suckleya suckleyana (Torr.) Rydb.: 1; MO (8501); rip; 1550–1600 m.

Anacardiaceae

Rhus aromatica Aiton var. *trilobata* (Nutt.) A. Gray ex S. Watson: 65; CO (7923), HA (5085), MO (7843), QU (3673), SM (6022), UN (5681); rip, ppw, pmg, pmg-pjw, mxs, ppw-pjw, rip-row, ari, rds, pjw, riw, pmg-rip, oaw, rsl, row, rip-oaw, rsl-riv; 1100–2350 m.

Rhus microphylla Engelm. ex A. Gray: 4; SM (6061), QU (9685), SM (9605); mxs, pmg, ppw, rds; 1200–1350 m.

Toxicodendron rydbergii (Small ex Rydb.) Greene: 17; CO (6735), HA (5440), MO (4728), SM (6114), UN (5546); rip-ppw, oaw-rip, rip-ppw, mcw-rip, mog-lac, rip, ppw-pjw, mog-rip, pjw; rip-pmg; 1400–2400 m.

Apiaceae

Ammoselinum popei Torr. & A. Gray: 2; SM (NS-9630); pmg, ppw; 1200–1300 m.

Angelica grayi (J. M. Coult. & Rose) J. M. Coult. & Rose: 1, UN (7983); oaw; 1550–1600 m.

Berula erecta (Huds.) Coville var. *incisa* (Torr.) Cronquist: 2; HA (8293 A), UN (8008); pmg, oaw; 1300–1600 m.

Cicuta maculata L. var. *angustifolia* Hook.: 3; CO (7918), UN (7981); rip, mog-rip, oaw; 1550–2600 m.

!! *Conium maculatum* L.: 2; CO (1837), SM (6139); rds, rip; 1950–2350 m.

Cymopterus acaulis (Pursh) Raf.: 3; UN (3595); rip-pmg, rds; 1400–1600 m.

Cymopterus lemmonii (J. M. Coult. & Rose) Dorn: 4; CO (6704); rip-ppw, rip, mcw-rip, mog-lac; 2250–2450 m.

Cymopterus montanus Torr. & A. Gray: 10; HA (4419), QU (NS-9805) SM (3887), UN (4229); pmg-pjw, rip-pmg, pmg-lac, pjw, rip-oaw, rds, pmg; 1350–1950 m.

Harbouria trachypleura (A. Gray) J. M. Coult. & Rose: 11; CO (4687), HA (8640), MO (6403), SM (6152); rip-ppw, pmg, mog-rip, ppw, lac, rip, ari, pjw, pjw-ppw; 1800–2400 m.

Heracleum sphondylium L. var. *lanatum* (Michx.) Dorn: 3; CO (6673), MO (8852); rip, rip-ppw; 2300–2500 m.

Ligusticum porteri J. M. Coult. & Rose: 3; CO (5309); oaw-rip, mog-rip, mog-lac; 2250–2600 m.

Osmorhiza longistylis (Torr.) DC.: 1; UN (5145); mcw-rip; 2150–2200 m. Specimen collected in basalt substrate.

! *Pastinaca sativa* L.: 1; CO (8762); rds; 2450–2500 m.

Apocynaceae

Apocynum androsaemifolium L.: 2; HA (DH-11729), MO (6411); rip; 1550–2350 m.

Apocynum cannabinum L.: 6; CO (6725), HA (5072), UN (5658); rip-ppw, pmg, mxs, pmg-rip, riw; 1300–2350 m.

Apocynum X floribundum Greene: 1; UN (8032); oaw; 1550–1600 m.

Asclepias arenaria Torr.: 2; HA (8246); UN (2034); pmg, pmg-rsl; 1300–1400 m.

Asclepias asperula (Decne.) Woodson var. *asperula*: 7; HA (4443), MO (4545), QU (NS-9692), SM (4835), UN (6971); pmg-pjw, rds, mxs, pjw, ari, pmg; 1350–200 m.

Asclepias engelmanniana Woodson: 17; HA (5370), MO (7830), QU (6997), SM (8901), UN (5621); mxs, rip, pmg, ari, rds, pmg-rip; 1350–1900 m.

Asclepias involucrata Engelm. ex Torr.: 4; CO (5480), HA (NS-9466), UN (5213); rds, pmg, rsl-riv; 1400–2000 m.

Asclepias latifolia (Torr.) Raf.: 28; HA (7773), QU (2710), SM (5960), UN (5820); pjw, pmg, mxs, rds, pmg-rip, riw, rip, row, rip-row; 1300–1800 m.

Asclepias macrosperma Eastw. 6; HA (6597), MO (8598), SM (8899); rip, mxs; 1450–1900 m.

Asclepias oenotheroides Cham. & Schltdl.: 1; UN (2152); rsl; 1350–1400 m.

Asclepias pumila (A. Gray) Vail: 10; HA (7745), UN (8029); pjw, oaw, pmg-rip, pmg, rds, rip-row; 1350–1800 m.

Asclepias speciosa Torr.: 4; CO (7162), HA (4902), UN (7987); ari, lac, pal, oaw; 1400–2000 m.

Asclepias subverticillata (A. Gray) Vail: 17; CO (7158), HA (6601), MO (8568), SM (5973), UN (1721); ari, lac, rip, pjw, pmg, rds, fog-ari; 1300–2000 m.

Asclepias tuberosa L. var. *interior* (Woodson) Shinners: 1; SM (6299); rip-pmg; 2200–2250 m.

Asclepias viridiflora Raf.: 7; HA (5861), UN (5565); pmg, rip, pmg-rip, ari; 1400–1750 m.

Funastrum crispum (Benth.) Schltdl.: 3; HA (3038), SM (6031), UN (5675); mxs, riw; 1250–1550 m.

Araceae

Lemna minor L.: 3; SM (6127), UN (6799); rip, ari, riw; 1400–2000 m.

**Lemna* aff. *minor* L.: 1; UN (5189); mcw-rip; 2150–2200 m.

Asparagaceae

! *Asparagus officinalis* L.: 3; CO (4281); lac, pmg, ari; 1750–2000 m.

Asteraceae

Achillea millefolium L. var. *lanulosa* (Nutt.) Piper: 19; CO (8736), HA (5101), MO (8799), SM (7100), UN (7986); rds, rip, rip-ppw, ppw, mog-lac, rip, ari, rip-pmg, mcw-rip, oaw; 1550–2450 m.

Agoseris glauca (Pursh) Raf. var. *glauca*: 3; CO (7517), UN (4217); mog-lac, mog-rip, rip-oak; 1900–2300 m.

Ambrosia artemisiifolia L.: 1; SM (2298); rds; 1950–2000 m.

Ambrosia confertiflora DC.: 29; HA (7296), MO (2236), SM (8182), UN (8012); rip-pmg, rip, pmg, pjw, mxs, rds, oaw, fog, pmg-rsl; 1350–2000 m.

Ambrosia psilostachya DC.: 38; HA (7215), MO (8531), QU (2688), SM (8108), UN (7706); pmg, rip, rds, pmg-rip, ari, pmg-rsl, rip-row; 1300–2500 m.

Ambrosia tomentosa Nutt.: 8; CO (8743), MO (8808), SM (7101); rds, ari, lac, rip, fog-ari; 1800–2500 m.

Ambrosia trifida var. *texana* Scheele: 4; CO (1851), UN (7969); rds, oaw, rip; 1350–2350 m.

* *Amphiachyris* aff. *dracunculoides* (DC.) Nutt.: 1; UN (2391), rip; 1350–1400 m.

Antennaria marginata Greene: 3; CO (6720), HA (5456); rip, rip-ppw; 1700–2450 m.

Antennaria parvifolia Nutt.:17; CO (7898), HA (NS-9495), MO (4770), SM (3707), UN (4235); pmg, rip, oaw-rip, ppw, mog-lac, mog, mcw, lac, mog-rip, rip-ppw, pjw, mcw-rip, rip-oaw, eiw; 1550–2650 m.

Antennaria rosea Greene: 3; CO (4685), MO (3355); rip-ppw, mcw-rip, rip; 1800–2500 m.

Antennaria rosulata Rydb.: 1; UN (1014); pmg; 1500–1550 m.

Aphanostephus skirrhobasis (DC.) Trel.: 1; HA; pmg; 1300–1350 m. Collected in sandy soil.

! *Arctium minus* Bernh.: 3; CO (7497), MO (8514), UN (7974); mog-lac, rip, oaw; 1550–2300 m.

Artemisia bigelovii A. Gray: 1; MO (DH-12079); 1700–1800 m.

Artemisia campestris L. var. *pacifica* (Nutt.) M. Peck : 3; CO (8768); rds, mog-rip; 2450–2600 m.

* *Artemisia* aff. *campestris* L.: 1; UN (600); pmg; 1400–1450 m.

Artemisia carruthii A. W. Wood ex Carruth: 6; HA (DH-11708), MO (2250), UN (1440); rds, rip-pmg, pmg; 1300–1950 m.

Artemisia dracunculus L.: 6; CO (7926), MO (8809), UN (7977); rip, oaw, mog-rip, rds; 1550–2600 m.

* *Artemisia* aff. *dracunculus* L.: 1; QU (2692); rds; 1300–1350 m.

Artemisia filifolia Torr.: 30; CO (6631 B), HA (8398), MO (7839), SM (8122), UN (1993); rip, pmg, pmg-rip, rds, rip-row; 1300–2450 m.

Artemisia franserioides Greene: 1; SM (BR-8872); 2800–2900 m.

Artemisia frigida Willd.: 17; CO (9028), HA (7749), MO (8819), SM (8942), UN (8682); lac, rip, rds, mog-rip, pjw, pmg, rip, fog-ari, mxs, pmg-rip, oaw, fog; 1500–2600 m.

* *Artemisia* aff. *frigida* Willd.: 1; HA (757); pmg; 1800–1850 m.

SR *Artemisia ludoviciana* Nutt. var. *incompta* (Nutt.) Cronquist: 9; CO (7905), HA (3045), MO (8810), QU (2695), SM (6048), UN (2143); rip, ppw, mxs, rds, rsl, rip-row; 1250–2500 m. This report is a state record; the closest records (Kartesz, pers. comm., 2008; Flora North America Vol. 19:529) come from Baca and Las Animas counties in Colorado.

Artemsisa ludoviciana Nutt. var. *latiloba* Nutt.: 1; CO (9121); mog-rip; 2550–2600 m. FNA lists this name as a synonym of var. *candicans* (Rydb.) H. St. John. According to FNA the nearest known occurrences are Utah and Wyoming, although the forthcoming Floristic Synthesis of Kartesz (pers. comm., 2008) has records for this taxon under the subspecific epithet *candicans* (Rydb.) Keck as occurring south and west of the study area in Guadalupe and Sandoval counties, respectively.

Artemisia ludoviciana Nutt. var. *ludoviciana*: 24; CO (8787), HA (5447), MO (8580), SM (8902), UN (8028); rds, rip, ppw, mog-lac, pjw-row, pmg, ari, oaw, pmg-pjw; 1400–2350 m.

* *Artemisia* aff. *tridentata* Nutt.: 3; HA (725); pmg; 1750–1850 m.

Artemisia tridentata Nutt. var. *tridentata*: 3; HA (8627), UN (1439); pmg, rip-pmg; 1700–1850 m.

Artemisia tridentata Nutt. var. *wyomingensis* (Beetle & Young) S. L. Welsh: 2; MO (8579), UN (1994); rip, rds; 1550–1700 m.

Baccharis pteronioides DC.: 3; HA (8297), QU (6985), SM (4833); mxs, rds, pmg; 1150–1800 m.

Baccharis salicina Torr. & A. Gray: 3; HA (8401), UN (8712); rip, pmg-rip; 1400–1550 m.

Baccharis wrightii A. Gray: 6; HA (4418), SM (6046 A), UN (5739); pmg-pjw, pmg, rip-pmg, mxs, riw; 1250–1450 m.

Bahia dissecta (A. Gray) Britton: 1; HA (DH-12195); pmg; 1700 m. [= *Amauriopsis dissecta* (A. Gray) Rydb.]

Bahia pedata A. Gray.: 3; QU (6983), SM (6058); ari-rds, mxs; 1150–1500 m.

Berlandiera lyrata Benth.: 68; HA (4407), MO (4567), QU (4477), SM (6091), UN (5545); pmg-pjw, pmg, rip-pmg, pal, rip, mxs, rds,ari, lac, oaw, pjw, riw, pmg-rsl, rds, rip-row; 1150–2200 m.

Bidens bipinnata L.: 1; UN (2536); rip-row; 1350–1400 m.

Bidens comosa (A. Gray) Wiegand: 2; MO (8529); rip; 1550–1600 m.

Brickellia brachyphylla (A. Gray) A. Gray: 5; HA (8390), MO (DH-12188), SM (8875), UN (1611); rip, mxs, pmg-pjw, rsl; 1450–1900 m.

Brickellia californica (Torr. & A. Gray) A. Gray var. *californica*: 1; UN (8685), pmg-rip; 1500–1550 m.

Brickellia eupatorioides (L.) Shinners var. *chlorolepis* (Wooton & Standl.) B. L. Turner: 2; CO (9027), UN (2854); lac, pmg; 1400–1850 m.

Brickellia grandiflora (Hook.) Nutt. var. *grandiflora*: 2; CO (7921); rip, mog-rip; 1550–2600 m.

!! *Carduus nutans* L.: 11; CO (7473), MO (7841), SM (6158); ppw, lac, rip, ari, pmg, fog-ari; 1550–2300 m.

Centaurea americana Nutt.: 1; SM (7023); rds; 1200–1250 m. [=*Plectocephalus americana* (Nutt.) D. Don in R. Sweet]

! *Centaurea biebersteinii* DC.: 1; CO (7901); rip; 1550–1600 m.

Chaetopappa ericoides (Torr.) G. L. Nesom: 92; CO (4672), HA (4308), MO (2239), QU (4465), SM (4821) UN (5229); rip-ppw, lac, rds, pmg-lac, fog, pmg, pal, rip-pmg, rip, pjw, mxs, ari, oaw, pmg-pjw, rai-pmg ; 1150–2050 m.

Chrysanthemum leucanthemum L.: 1; CO (5317); oaw-rip; 2350–2400 m. [=*Leucanthemum vulgare* Lamark.]

Chrysothamnus pulchellus (A. Gray) Greene var. *baileyi* (Wooton & Standl.) S. F. Blake: 1; UN (2221); pmg; 1450–1500 m. [=*Lorandandersonia baileya* (Wooton & Standl.) Urbatsch, R.P. Roberts & Neubig]

Chrysothamnus vaseyi (A. Gray) Greene: 1; HA (8371); rip; 1300–1350 m.

! *Cichorium intybus* L.: 1; SM (7046); ari; 2000–2050 m.

!! *Cirsium arvense* (L.) Scop.: 4; CO (7155); ari, lac, mog-lac, mog-rip; 1800–2600 m.

Cirsium ochrocentrum A. Gray: 49; HA (7274), MO (2260), QU (7000), SM (2338), UN (7638); rip-pmg, mxs, rds, ari, rsl, pmg-pjw, rip, fog, row, rip-row; 1150–2000 m.

Cirsium parryi (A. Gray) Petrak subsp. *parryi*: 3; CO (6688); rip, mog-lac; 1600–2450 m.

Cirsium scariosum Nutt. var. *coloradense* D. J. Keil: 1; CO (9125); mog-rip; 2550–2600 m.

Cirsium undulatum (Nutt.) Spreng. var. *undulatum*: 61; CO (6736), HA (5465), MO (4578), QU (4484), SM (6145), UN (5629); rip-ppw, lac, rds, ppw, rip, mog-lac, ari, mog-rip, mxs, pmg, pjw, pmg-rip, fog-ari, riw, pmg, oaw, pmg-rsl, fog, rip-row; 1350–2600 m.

!! *Cirsium vulgare* (Savi) Ten.: 2; CO (7941), MO (2478); rip; 1550–2500 m.

Conyza canadensis (L.) Cronquist var. *canadensis*: 20; CO (9037), HA (7298), MO (8833), SM (8210), UN (8708); lac, ari, rip-pmg, pjw, rip, pmg, mxs, fog-ari, rds; 1150–2500 m.

Coreopsis lanceolata L.: 1; UN (4033); rds; 1350–1400 m.

Coreopsis tinctoria Nutt. var. *tinctoria*: 2; MO (DH-11733); 1600–1650 m.

Crepis runcinata (E. James) Torr. & A. Gray var. *glauca* (Nutt.) B. Boivin: 2; HA (4901), pal, rip; 1300–1350 m.

Crepis runcinata (E. James) Torr. & A. Gray var. *runcinata*: 1; CO (9062); mog-rip; 2550–2600 m.

Cyclachaena xanthifolia (Nutt.) Fresen.: 4; HA (8321), MO (8845), UN (8004); pmg, rip, oaw; 1300–2500 m. [=*Iva xanthifolia* Nutt.]

Dietaria bigelovii (A. Gray) D. R. Morgan & R L. Hartman var. bigelovii: 1; CO (9050); mog-rip; 2550–2600 m. [=*Machaerantheram bigelovii* (A. Gray) Greene]

Dieteria canescens (Pursh) Nutt. var. *canescens*: 1; CO (8784); rds; 2450–2500 m. [=*Machaeranthera canescens* (Pursh) A. Gray var. *canescens*]

Dieteria canescens (Pursh) Nutt. var. *glabra* (A. Gray) D. R. Morgan & R. L. Hartman: 1; SM (2331); rds; 1950–2000 m. [=*Machaeranthera canescens* (Pursh) A. Gray var. *glabra*]

Dyssodia papposa (Vent.) Hitchc.: 9; HA (3051), MO (DH-12191), UN (1515); mxs, pmg, pmg-pjw, pmg-rsl, rds; 1500–1700 m.

Engelmannia pinnatifida A. Gray ex Nutt.: 87; CO (5504), HA (5916), MO (8509), QU (6989), SM (6138), UN (5707); rds, pmg, pmg-lac, rip, mxs, pjw, ppw, ari, pmg-rip, riw, row, pjw-pmg, fog, pmg-rsl; 1150– 2200 m.

Ericameria nauseosa (Pall. ex Pursh) G. L. Nesom & G. I. Baird var. *glabrata* (A. Gray) G. L. Nesom & G. I. Baird: 4; CO (7860), UN (8006); rip, lac, oaw, pmg-pjw; 1550–1700 m.

Erigeron bellidiastrum Nutt. var. *bellidiastrum*: 15; HA (4946), QU (3656), SM (3809), UN (5616); pmg, rip, rip-pmg, rds; 1250–1550 m. Many collected from sandy soils.

Erigeron canus A. Gray: 10; CO (4636), HA (5873 A), SM (4520), UN (3959); pmg, lac, rds, fog, pmg-lac; 1700–2050.

Erigeron colomexicanus A. Nelson: 57; CO (5127), HA (5899), MO (6232), SM (6153 B), UN (5737); mxs, lac, rds, pmg-lac, pmg, fog, mxs-lac, rip, ppw, oaw, pjw, rip-pmg, riw, ari, pjw-ppw, pjw-oaw; 1400–2200 m.

Erigeron coulteri Porter: 1; CO (6679), rip; 2400–2450 m.

Erigeron divergens Torr. & A. Gray var. *divergens*: 28; CO (4289), HA (5429), MO (4568), QU (3687), SM (6165), UN (3217); lac, rip-ppw, rds, ppw, mog-lac, rip, mxs, pmg-rip, pjw, pmg, ari, fog-ari; 1300–2300 m.

Erigeron flagellaris A. Gray: 29; CO (4637), HA (5441), MO (4761), QU (2689), UN (7979); pmg, mcw-rip, rip, oaw-rip, rip-ppw, mog-lac,ppw, rip-pmg, lac, mog-rip, rds, oaw; 1300–2400 m.

Erigeron leiomerus A. Gray: 1; CO (3431); mcw; 2400–2450 m.

Erigeron pumilus Nutt. var. *pumilus*: 2; CO (9307), HA (4439); pmg-pjw, pmg; 1400–2500 m.

Erigeron speciosus (Lindl.) DC.: 2; CO (7576); mog-lac, mog-rip; 2300–2600 m.

& *Erigeron subglaber* Cronquist: Not collected but known from study area in San Miguel county (Tables 10, 11).

* *Erigeron* aff. *subtrinervis* Rydb.: 4; CO (7885), MO (8797); rip, mog-lac, mog-rip; 1550–2600 m.

Erigeron subtrinervis Rydb. ex Porter & Britton var. *subtrinervis*: 1; CO (6663); rip; 2400–2450 m.

Evax prolifera Nutt. ex DC.: 5; HA (4332), SM (5940 B), UN (5805); pmg, rds, pmg, rip-pmg; 1300–1500 m.

Evax verna Raf.: 6; HA (4367), SM (4860); rip-pmg, pmg-pjw, rds, mxs; 1300–1450 m.

Gaillardia pinnatifida Torr.: 28; HA (4601), SM (8422), UN (1359); pmg-lac, rip, mxs, rds, pjw, rip-pmg, riw, rsl, pmg, pmg-rsl, rip-row; 1350–1850 m.

Gaillardia pulchella Foug. var. *pulchella*: 25; HA (4969), QU (4488), SM (6012); rip, pmg, rip-pmg, ari, ari-rds, rds, mxs, rsl-pmg, ppw; 1150–1700 m.

~ *Grindelia acutifolia* Steyerm.: 3; CO (8730), UN (2734); rds; 1300–2500 m. [See note in next entry.]

# *Grindelia inornata* Greene: 6; MO (DH-12220), UN (2048); pmg-rsl, rds, rip-pmg, pmg; 1300–1650 m. Some authors consider *G. acutifolia* and *G. inornata* synonyms of *G. hirsutula* Hook. & Arn., e.g. FNA.

Grindelia nuda A. W. Wood var. *aphanactis* (Rydb.) G. L. Nesom: 34; CO (5518), HA (396), MO (7798), QU (2707), SM (7060), UN (7365); rds, ari, ppw, rip, pjw, rip-pmg, pmg, fog-ari, rsl, pmg-pjw, rip-row; 1350–2500 m. [See note under *G. squarrosa*.]

Grindelia nuda A. W. Wood var. *nuda*: 12; CO (9009); HA (8372); MO (2255); SM (8130), UN (6932); lac, rip, pmg, rds, pmg-rip; 1350–2000 m. [See note under *G. squarrosa*.]

Grindelia squarrosa (Pursh) Dunal var. *squarrosa*: 6; CO (7596), UN (8064); mog-lac, ppw, rds, mog-rip, oaw; 1550–2600 m. Some authors synonymize *G. nuda* under *G. squarrosa*.

Gutierrezia sarothrae (Pursh) Britton & Rusby: 41; CO (8985), HA (8625), MO (7815), QU (2682), SM (8957), UN (1538); lac, rds, mog-rip, pmg, rip, pjw, mxs, for-ari, fog, pmg-rsl, rip-pmg, rip-row; 1300–2500 m.

Gutierrezia sphaerocephala A. Gray: 5; HA (7276), QU (6990), SM (8209); rip-pmg, pmg, pmg, rds; 1150–1400 m.

Helenium autumnale L. var. *montanum* (Nutt.) Fernald: 1; MO (8851); rip; 2450–2500 m.

Helianthella parryi A. Gray: 1; CO (7877); rip; 1550–1600 m.

Helianthus annuus L.: 38; CO (6763), HA (8635), MO (8839), QU (2699), SM (8175), UN (7394); rds, lac, ari, ppw, pmg, rip, mxs, fog-ari, pmg-rip, oaw, pmg-pjw, fog, row; 1300–2500 m.

Helianthus ciliaris DC.: 3; SM (7039), UN (5220); ari, fog-ari, pmg; 1450–2050 m.

Helianthus petiolaris Nutt. var. *fallax*: 17; CO (9095), HA (8327), MO (8535), QU (6984), SM (8105), UN (8663); mog-rip, pmg, rip, rip-pmg, rds, pmg-pjw; 1350–2600 m.

Helianthus petiolaris Nutt. var. *petiolaris* (Heiser) B. L. Turner: 27; HA (5019), SM (4889), UN (5626); pmg, mxs, pal, rds, mxs, ari, pmg-rip, rip; 1150–2000 m.

Helianthus pauciflorus Nutt. subsp. *subrHomboideus* (Rydb.) O. Spring & E. E. Schilling: 1; CO (8717), rds, 2450–2500 m. [=*Helianthus rigidus* (Cass.) Desf. var. *subrhomboideus* (Rydb.) Cronquist]

Heliomeris multiflora Nutt. var. *multiflora*: 4; CO (8727), MO (8798); rds, rip; 2300–2500 m. [=*Viguiera multiflora* (Nutt.) S. F. Blake]

Heliomeris multiflora Nutt. var. *nevadensis* (A. Nelson) W.F. Yates: 3; CO (9096), UN (7992); mog-rip, rds, oaw; 1550–2600 m. [=*Viguiera multiflora* (Nutt.) S. F. Blake var. *nevadensis* A. Nelson]

Heliopsis helianthoides (L.) Sweet var. *scabra* (Dunal) Fernald: 3; CO (7512), UN (8036); mog-lac, rds, oaw; 1550–2350 m. [=*Heliopsis helianthoides* (L.) Sweet var. *occidentalis* (T. R. Fisher) Steyerm.]

Herrikia horrida Wooton and Standl.: 1; MO (DH-12205); rsl; 1500–1600 m.

Heterosperma pinnatum Cav.: 1; HA (DH-12210); pjw; 1500–1600 m.

Heterotheca canescens (DC.) Shinners: 5; HA (444), MO (2248), UN (8024); ppw-pjw, rds, oaw, pmg; 1600–1950 m.

Heterotheca subaxillaris (Lam.) Britton & Rusby: 10; HA (8363), UN (7680); rip, rip-pmg, rip-row, pmg; 1300–1500 m.

* *Heterotheca* aff. *villosa* (Pursh) Shinners: 1; UN (1882); rds-rip; 1550–1600 m.

Heterotheca villosa (Pursh) Shinners var. *foliosa* (Nutt.) Harms: 12; CO (7910), HA (7756), MO (8536), SM (8187), UN (568); rip, pjw, pmg, rip-pmg, rds; 1150–1850 m.

? *Heterotheca villosa* (Pursh) Shinners var. aff. *foliosa* (Nutt.) Harms: 1; UN (2789); pmg; 1400–1450 m.

Heterotheca villosa (Pursh) Shinners var. *minor* (Hook.) Semple: 18; CO (9088), HA (8391), SM (6161), UN (1056); mog-rip, rip, pjw-row, fog-ari, rip-pmg, ari, row, pmg, rds; 1300–2250 m.

? *Heterotheca villosa* (Pursh) Shinners var. aff. *minor* (Hook.) Semple: 2; HA (3064), UN (2847); mxs, pmg; 1400–1550 m.

Heterotheca villosa (Pursh) Shinners var. *nana* (A. Gray) Semple: 18; CO (9007), SM (8889), UN (1150); pjw, rds, lac, mxs, riw, pmg, fog, rip-pmg, rip-row; 1350–2500 m.

Hymenopappus filifolius Hook. var. *cinereus* (Rydb.) I. M. Johnst.: 6; HA (4600), MO (6185), SM (4511), UN (3956); pmg-lac, pmg, ppw, lac; 1550–2200 m.

Hymenopappus flavescens A. Gray var. *flavescens*: 17; HA (4328), QU (6998), SM (4876), UN (5759); pmg, ari, rds, riw, rip; 1100–1550 m.

Hymenopappus newberryi (A. Gray) I. M. Johnst.: 2; CO (6684), MO (6404); rip, rip-ppw; 2300–2450 m.

Hymenopappus filifolius var. *polycephalus* (Osterh.) B.L. Turner:

74; CO (5513), HA (4442), MO (4561) QU (4487), UN (5235); rds, ppw, pmg-pjw, pmg, mxs, rip-pmg, rip, pjw, ari, riw, oaw, rsl, rip-row; 1150–2300 m.

Hymenopappus tenuifolius Pursh: 2; CO (6455), UN (2028); fog, pmg-rsl; 1350–2000 m.

Hymenoxys odorata DC.: 9; HA (4321), SM (3858), UN (2573); pmg, rip-pmg, rds; 1350–1500 m.

Hymenoxys richardsonii (Hook.) Cockerell var. *floribunda* (A. Gray) Parker: 1; SM (2322), rds; 1900–1950 m.

Hymenoxys richardsonii (Hook.) Cockerell var. *richardsonii*: 4; CO (7437); ppw, rip, mog-lac; 1550–2350 m.

Iva axillaris Pursh: 9; CO (5341), HA (8442), SM (7042); lac, pmg, ari, rip, mxs-lac; 1450–2050 m.

Lactuca canadensis L. var. *longifolia* (Michx.) Farw.: 2; CO (7518), UN (1763); mog-lac, rds; 1950–2300 m.

! *Lactuca serriola* L.: 22; CO (8994), HA (8296), MO (8841), SM (8962), UN (8050); lac, rds, pmg, rip, pjw, rip-pmg, fog-ari, oaw; 1300–2500 m.

Liatrus punctata Hook. var. *mucronata* (DC) B. L. Turner in B. L. Turner et al.: 7; CO (8770), UN (1773); rds, pmg-rip, pmg; 1400–2500 m. This specimen needs more attention. Not previously known in NM [=*L. mucronata* DC.]

Liatris punctata Hook. var. *punctata*: 10; CO (9029), HA (8271), QU (2676), UN (2581); lac, pmg, rds, rip-pmg; 1300–1850 m.

Lygodesmia juncea (Pursh) D. Don ex Hook.: 14; CO (9010), HA (6587), MO (8571), UN (2394); lac, rip, mxs, pmg, rds, pmg-rip; 1400–1950 m.

* *Lygodesmia* aff. *juncea* (Pursh) D. Don ex Hook.: 4; HA (5872); pmg, pal, rip; 1300–1750 m.

Machaeranthera tanacetifolia (Kunth) Nees: 83; CO (6759), HA (5403), MO (4560), QU (3682), SM (4879), UN (5553); rds, lac, mxs, rip-pmg, pmg-pjw, rip, pmg-lac, pmg, ari, pjw, riw, rsl-pmg; 1250–2000 m.

Melampodium leucanthum Torr. & A. Gray: 90; HA (4438), MO (7809), QU (4485), SM (6081), UN (5715); pmg-pjw, pmg, pmg-lac, rip, mxs, pjw, ppw-pjw, pjw-row, mes-lac, ari, rds, oaw, rip-pmg, riw, rsl, pmg-pjw, pmg-rsl, fog, rip-row, rsl-riv, ppw; 1150–2250 m.

Mulgedium pulchellum (Pursh) G. Don in R. Sweet: 5; CO (9044), MO (8537), UN (1764); mog-rip, rip, rds; 1550–2600 m. [=*Lactuca oblongifolia* Nutt.]

Packera fendleri (A. Gray) W. A. Weber & A. Löve: 1; CO (7868); rip; 1550–1600 m.

Packera neomexicana (A. Gray) W. A. Weber & A. Löve var. *mutabilis* (Greene) W. A. Weber & A. Löve: 26; CO (5490), HA (3307), MO (6184), SM (6151), UN (3951); rds, rip-ppw, oaw-rip, fog, pmg, mxs-lac, ppw, rip, lac, rip-pmg, pjw, mxs; 1400–2400 m.

Packera plattensis (Nutt.) W. A. Weber & A. Löve: 9; HA (5394), SM (6136), UN (5197 A); mxs, pmg-lac, mcw-lac, rip, pjw, pjw-ppw, rds; 1550–2000 m.

& *Packera spellenbergii* (T. M. Barkley) C. Jeffrey: Not collected but known from study area in Union and Harding counties (Tables 10, 11).

Packera tridenticulata (Rydb.) W. A. Weber & A. Löve: 24; CO (5337), HA (5890), MO (4569), SM (3781), UN (5196); lac, rip-ppw, rip, lac, pmg, mxs-lac, rds, rip-pmg, mcw-rip, pjw-pmg, pjw-oaw; 1350–2450 m.

Palafoxia sphacelata (Nutt. ex Torr.) Cory: 14; HA (5041), UN (7700); pmg, rip-pmg, rip, rds; 1250–1550 m.

Parthenium confertum A. Gray: 2; HA (6591), MO (8601); rip; 1550–1600 m.

Parthenium incanum Kunth: 1; HA (NS-9464); rsl-riv; 1550–1600 m.

Pectis angustifolia Torr. var. *angustifolia*: 4; UN (2187); pmg, rds, rip-row; 1300–1550 m.

Pericome caudata A. Gray: 3; HA (DH-12121), CO (7872), MO (DH-12186); rip, rsl; 1550–1700 m.

* *Picradeniopsis* aff. *oppositifolia* (Nutt.) Rydb. ex Britton: 3; HA (4305), MO (8516), UN (204); pmg, rip; 1350–1600 m.

Picradeniopsis oppositifolia (Nutt.) Rydb. ex Britton: 27; CO (6446), HA (8624), SM (8951), UN (1511); fog, mxs, pmg, fog-ari, riw, rds, rip-pmg, pmg-pjw, pjw-mxs; 1300–2050 m

Picradeniopsis woodhousei (A. Gray) Rydb.: 17; HA (5870), MO (8505), UN (5541); pmg, rip, pal, pmg-rip, rds, rip-row; 1400–1750 m.

Pseudognaphalium canescens (DC.) W. A. Weber: 1; HA (DH 12217); rsl; 1700 m.

Pseudognaphalium stramineum (Kunth) W. A. Weber: 6; HA (7221), SM (8095), UN (7692); pmg, rip, pmg-rip, ari; 1350–1600 m.

Psilostrophe tagetina (Nutt.) Greene: 20; HA (9434), MO (4558), QU (4457), SM (6088), UN (2740); rip, pmg, mxs, rds, ari, rip-pmg; 1150–1700 m.

Pyrrhopappus pauciflorus (D. Don) DC.: 1; MO (6351), rds, 2250–2300 m.

Pyrrocoma crocea (A. Gray) Greene var. *crocea*: 1; MO (BR-8424); 2900–3000 m.

Ratibida columnifera (Nutt.) Wooton & Standl.: 91; CO (6786), HA (6607), MO (8805), QU (4461), SM (5953), UN (5217); rds, mog-rip, ari, ppw, rip, pmg, rip-pmg, pjw, ppw-pjw, mxs, fog-ari, riw, oaw, fog, row, pmg-rsl, pmg-pjw; 1150–2600 m.

Ratibida tagetes (E. James) Barnhart: 36; CO (9004), HA (8295), MO (7822), QU (2690 B), SM (5992), UN (7363); lac, pmg, rip-pmg, pjw, rip, ppw-pjw, rds, ari, fog-ari, oaw, pmg-pjw, fog; 1300–2050 m.

Rudbeckia hirta L. var. *pulcherrima* Farw.: 4; CO (7449); ppw, rip, mog-lac, mog-rip; 1550–2600 m.

Rudbeckia laciniata L. var. *ampla* (A. Nelson) Cronquist: 9; CO (6729), MO (8830), UN (7997); rip-ppw, rip, mog-lac, mog-rip, rip-ppw, oaw; 1550–2500 m.

! *Scorzonera laciniata* L.: 24; CO (4658), HA (4612), MO (4554), SM (6135), UN (5522); pmg, lac, pmg-lac, rds, mxs-lac, ppw, oaw, rip, ari, fog-ari, rip-pmg, pjw, rip-oaw; 1350–2050 m.

Senecio bigelovii A. Gray var. *hallii* A. Gray: 2; CO (7578), SM (BR-8548); mog-lac; 2250–2800 m.

Senecio crassulus A. Gray: 2; CO (5328), oaw-rip, mcw; 2350–2450 m.

Senecio eremophilus Richardson var. *kingii* (Rydb.) Greenm.: 1; CO (9053); mog-rip; 2550–2300 m.

Senecio flaccidus Less. var. *douglasii* (DC.) B. L. Turner & T. M. Barkley: 27; HA (5397); MO (8582), QU (4478), SM (2310), UN (5745); mxs, pmg, rip, ari, rds, riw, rip-pmg, pmg-pjw, row, fog, rsl, rip-row; 1150–200 m.

Senecio pudicus Greene: 2; CO (6628); rip, ppw; 2300– *Aster ascendens* Lindl.: 1; UN (8035); oaw; 1550–1600 m. [= *Symphyotrichum ascendens* (Lindl.) Nesom]

Senecio riddellii Torr. & A. Gray: 3; HA (3070), MO (7823), UN (5746); mxs, pmg, riw; 1400–1600 m. [= *S. spartoides* Torr. & A. Gray var. *fremontii* (Torr. & A. Gray) Greeenman]

* *Senecio* aff. *riddellii* Torr. & A. Gray: 2; UN (3024), pmg, 1400–1450 m.

Senecio triangularis Hook.: 1; CO (6657); rip; 2400–2450 m.

Solidago canadensis L var. *canadensis*: 3; CO (7914), MO (8843); rip, mog-rip; 1550–2600 m.

Solidago altissima L. var. *gilvocanescens* (Rydb) Semple: 11; CO (9002), UN (6940); lac, rds, pmg, oaw, rip-pmg, fog; 1450–2500 m. [= *Solidago canadensis* var. *gilvocanescens* Rydb.]

* *Solidago* aff. *canadensis* L.: 1; UN (2521); rip-row; 1350–1400 m.

Solidago gigantea Aiton: 3; CO (7445), SM (8914), UN (7685); ppw, mxs, rip-pmg; 1450–2300 m.

Solidago missouriensis Nutt.: 1; CO (7895), rip; 1550–1600 m.

Solidago mollis Bartl.: 2; UN (8053), HA (8621); oaw, pmg; 1550–1850 m.

* *Solidago* aff. *mollis* Bartl.: 4; HA (1343), UN (2594); pjw-row, pmg; 1500–1800. Union County plants collected on lava substrate.

Solidago parryi (A. Gray) Greene: 1; CO (9082), mog-rip; 2550–2300 m.

Solidago rigida L. var. *rigida*: 2; CO (8786 A), MO (8842); 2450–2500 m. [= *Oligoneuron ridigum* (L.) Small subsp. *rigidum*]

Solidago simplex Kunth var. *simplex*: 1; CO (7571), mog-lac; 2250–2300 m.

Solidago speciosa Nutt. var. *pallida* Porter: 1; CO (9116); mog-rip; 2550–2600 m.

Solidago velutina DC. subsp. *sparsiflora* (A. Gray) Semple: 1; UN (2450); rip; 1350–1400 m.

! *Sonchus asper* (L.) Hill: 21; CO (9000), HA (4347), MO (8527), QU (4486), SM (3784), UN (5683); lac, ppw, rip-pmg, mxs, rip, pmg, ari, riw; 1150–2300 m.

Stephanomeria pauciflora (Torr.) A. Nelson: 9; HA (8267), SM (5997), UN (5721); pmg, ari, mxs, riw, pmg-pjw; 1250–1850 m.

* *Stephanomeria* aff. *pauciflora* (Torr.) A. Nelson : 3; HA (5892), UN (1537); pmg-pjw, pmg; 1500–1750 m.

Symphyotrichum ericoides (Lindl.) Newsom: 1; UN (2622); pmg; 1500–1550 m. Collected from a lava substrate. [=*Aster ericoides* L. var. *ericoides*]

* *Symphyotrichum* aff. *ericoides* (Lindl.) Newsom: 2; CO (8990), HA (7737); lac, pjw; 1750–1800 m.

Symphyotrichum falcatum (Lindl.) Nesom: 1; CO (1839), rds; 2300–2350 m. [=*Aster falcatus* Lindl. var. *commutatus* (Torr. & A. Gray) A. G. Jones]

Symphyotrichum fendleri (A. Gray) Nesom: 1; UN (1539); pmg; 1650–1700 m. [=*Aster fendleri* A. Gray]

* *Symphyotrichum* aff. *frondosum*: 1; MO (8517); rip; 1550–1600 m.

Symphyotrichum laeve (L.) Löve & Löve var. *geyeri* (A. Gray) Nesom: 2; CO (1822), MO (8804); rds, rip; 2300–2500 m. [=*Aster laevis* L. var. *geyeri* A. Gray]

Symphyotrichum porteri (A. Gray) Nesom: 1; HA (DH-12074); 1700–1800 m. [=*Aster porteri* A. Gray]

* *Symphyotrichum* aff. *porteri* A. Gray: 1; HA (466); ppw-pjw; 1700–1750 m.

Tagetes micrantha Cavanilles: 1; HA (DH-12211); pjw; 1500–1600 m.

! *Taraxacum officinale* Weber ex F. H. Wigg.: 40; CO (4270), HA (8303), MO (4749), SM (4508), UN (608); lac, rds, oaw-rip, rip, mcw-rip, pmg, rip-ppw, ari, pmg-lac, ppw, mcw, mog, mxs-lac, mog-rip, pjw, rip-pmg, oaw; 1300–2650 m.

Tetradymia canescens DC.: 1; CO (7866); rip; 1550–1600 m.

Tetraneuris acaulis (Pursh) Greene var. *acaulis*: 39; CO (5493), HA (4606), MO (6186), SM (4530), UN (4249); rds, lac, rip-ppw, pmg-lac, pmg, mxs, ppw, lac, ari, rip-oaw, pmg-pjw, pmg-rip; 1350–2450 m.

Tetraneuris acaulis (Pursh) Greene var. *caespitosa* A. Nelson: 11; CO (3413), HA (4331), UN (3565); fog, pmg, mxs, rip, rds, rip-pmg, pmg-lac, pjw, pmg; 1350–2500 m.

Tetraneuris argentea (A. Gray) Greene: 3; SM (4822); mxs, rds; 1750–2000 m.

Tetraneuris scaposa (DC.) Greene var. *scaposa*: 73; HA (5021), MO (8512), QU (4476), SM (4823), UN (5228); pmg, pmg-pjw, pal, rip, pjw, mxs-lac, rds, rip-row, ari, mxs, riw, pmg-rip, row, rsl, rsl-riv, rsl-pmg, ppw; 1150–1800 m.

SR *Tetraneuris torreyana* (Nutt.) Greene: 2; HA (NS-9523), SM (3709); pjw-pmg; 1700–1800 m. To the best of our knowledge this is the first vouchered state record, as it was not reported by Flora of North America or Kartesz (pers. comm., 2008). Heil and O'Kane also report it for Apache Co., AZ, and FNA (21: 451) reports it from CO.

Thelesperma filifolium (Hook.) A. Gray var. *intermedium* (Rydb.) Shinners: 8; SM (6076), QU (9785); ari, mxs, pmg, rip-pmg, bdl, ppw; 1150–1500 m.

Thelesperma megapotamicum (Spreng.) Kuntze: 103; CO (7911), HA (6569), MO (4577), QU (4495), SM (4798), UN (5640); rip, fog, pmg-pjw, pmg, mxs, pjw, rds, ppw, ari, oaw, fog-ari, rip-pmg, riw, rsl, pmg-rsl, row, rip-row; 1150– 2250 m

Thelesperma subnudum A. Gray: 1; HA (DH-11644); 1800–1850 m.

Thymophylla acerosa (DC.) Strother: 1; SM (NS-9665); ppw; 1200–1250 m.

Townsendia grandiflora Nutt.: 2; HA (8636); pmg; 1800–1850 m.

! *Tragopogon dubius* Scop.: 90; CO (5502), HA (6606), MO (496), QU (4481), SM (4874), UN (5223); rds, lac, pmg, rip-ppw, mcw-rip, rip, mog-lac, ari, ppw, mog-rip, fog, pmg-lac, mxs, pal, pjw, fog-ari, pmg-rip, riw, oaw, row; 1150–2500 m.

! *Tragopogon porrifolius* L.: 4; MO (4556), UN (3544 A); rds, pmg; 1350–1700 m.

Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray var. *exauriculata* B. L. Rob. & Greenm.: 6; MO (8528), SM (2306), UN (2105); rip, rds, pmg, rip-pmg, rip-row; 1300–1950 m.

Vernonia marginata (Torr.) Raf.: 3; UN (7679); rip-pmg, rip, rip-row; 1350–1500 m.

Xanthisma spinulosum (Pursh) D. L. Morgan & R. L. Hartman: 10; CO (5348), HA (4932), MO (7820), UN (5205); pmg, lac, rip-pmg, riw; 1300–1850 m. [=*Machaeranthera pinnatifida* (Hook.) Shinners var. *glaberrima* (Rydb.) B. L. Turner & R. L. Hartman]

Xanthisma spinulosum (Pursh) D. L. Morgan &R. L. Hartman var. *paradoxa* D. L. Morgan & R. L. Hartman: 1; MO (DH-11743) [=*Machaeranthera pinnatifida* (Hook.) Shinners var. *paradoxa* B. L. Turner & R. L Hartman]

Xanthisma spinulosum (Pursh) D. L. Morgan &R. L. Hartman var. *spinulosum*: 105; CO (6447), HA (5844), MO (4553), QU (4491), SM (5926), UN (8023); pmg, rds, ari, lac, fog, pal, rip-pmg, rip, pmg-pjw, mxs, oaw, riw, row, pmg-rsl, rip-row, ppw, rsl-pmg; 1150– 2300 m. [=*Machaeranthera pinnatifida* (Hook.) Shinners var. *pinnatifida*]

Xantium strumarium L.: 10; CO (8995), HA (8264), MO (8559), UN (2509); lac, pmg, rip-row, rip, rip-pmg, pmg-pjw, pmg-rsl; 1300–1850 m.

Zinnia grandiflora Nutt: 76; CO (1811), HA (5017), MO (2246), QU (4475), SM (4861), UN (5568); rds, pmg, mxs, pal, pmg-pjw, rip, pjw-row, ari, fog-ari, riw, pmg-rip, rsl, row, fog, rip, rip-row; 1150–1950 m

Berberidaceae

Berberis fendleri A. Gray: 3; CO (6716); rip-ppw, rip; 1600–2350 m.

Mahonia fremontii (Torr.) Fedde: 1; SM (NS-9922); pjw; 1900–1950 m.

Mahonia repens (Lindl.) G. Don: 2; CO (7889); rip, mcw; 1550–2450.

Betulaceae

Alnus incana (L.) Moench var. *occidentalis* (Dippel) C. L. Hitchc.: 3; CO (7902), MO (6390); rip, mog-rip, rip-ppw; 1550–2700 m.

Betula occidentalis Hook.: 2; CO (6703), rip-ppw, rip; 2300–2450 m.

Boraginaceae

Cryptantha cinerea (Greene) Cronquist var. *jamesii* Cronquist: 15; HA (5089), QU (NS-9820), UN (5612); pmg, pmg-rip, rds; 1250–1850 m.

Cryptantha crassisepala (Torr. & A. Gray) Greene var. *elachantha* I. M. Johnst.: 32; HA (4433), QU (3670), SM (6067), UN (5232); pmg-pjw, pmg, pal, pmg-lac, rip, rip-pmg, mxs-lac, ari, rds, mxs, riw; 1150–1850 m.

Cryptantha fendleri (A. Gray) Greene: 1; SM (8895); mxs; 1850–1900 m.

Cryptantha minima Rydb.: 10; HA (5378), QU (9752), SM (3884), UN (3552); mxs, pmg, rds, rip-pmg; 1200–1850 m.

Cryptantha thyrsiflora (Greene) Payson: 12; CO (6449), HA (8619), UN (5751); fog, pmg, pjw, riw, ari, oaw, rds; 1400–1850 m.

**Cryptantha* aff. *thyrsiflora* (Greene) Payson: 1; UN (1136); fog; 1850–1900 m.

! *Cynoglossum officinale* L.: 14; CO (5314), MO (6405), UN (8030); oaw-rip, rip-ppw, mcw-rip, mog-lac, rip, ppw, mog-rip, rip-oaw, oaw; 1550–2400 m.

Ellisia nyctelea (L.) L.: 2; UN (4206); rip-oaw, mcw-rip; 1900–1950 m.

Hackelia floribunda (Lehm.) I. M. Johnst.: 3; CO (7542); MO (8853); mog-lac, rip; 2250–2500 m.

& *Hackelia hirsuta* (Wooton & Standley) I.M. Johnston: Not collected but known from study area in Colfax, Mora, and San Miguel county (Tables 10, 11).

Heliotropium convolvulaceum (Nutt.) A. Gray var. *convolvulaceum*: 9; HA (8350), UN (8657); rip, pmg-rip; 1300–1600 m.

Heliotropium curassavicum L. var. *obovatum* DC.: 1; CO (9031 A); lac ; 1800–1850 m.

Hydrophyllum fendleri (A. Gray) A. Heller var. *fendleri*: 2; CO (5315), oaw-rip, mcw-rip; 2250–2400 m.

Lappula occidentalis (S. Watson) Greene var. *cupulata* (A. Gray) L. C. Higgins: 47; CO (5122), HA (4431), MO (4571), QU (3671), SM (4824), UN (5814); rds, lac, fog, pmg-lac, pmg-pjw, rip-pmg, mxs-lac, ari, rip, pjw, pmg, rip-oaw, rsl-pmg; 1100–2200 m.

? *Lappula occidentalis* (S. Watson) Greene aff. var. *cupulata* (A. Gray) L. C. Higgins: 1; UN (3185); rds; 1550–1600 m.

**Lappula* aff. *occidentalis* (S. Watson) Greene var. *occidentalis*: 2; HA (NS-9510), SM (NS-9862); pjw-pmg, pjw; 1350–1950.

Lappula occidentalis (S. Watson) Greene var. *occidentalis*: 24; CO (6783), HA (4319), MO (6389), QU (4473), SM (4791), UN (5750); rds, mog-rip, pmg, rip, mxs-lac, ari, oaw, rip-pmg, pjw, riw, pjw-oaw; 1400–2300 m.

Lappula squarrosa (Retz.) Dumort.: 3; CO (9054), MO (3168); mog-rip, rip-row; 2550–2600 m.

Lithospermum incisum Lehm.: 32; CO (3414); HA (6578); QU (NS-9693), SM (3345); UN (5580); pmg-lac, rip, rds, mxs-lac, pmg, pjw, pmg-rip, rip-oaw, ari, pjw-ppw, pjw-oaw; 1150–2050 m.

Lithospermum multiflorum Torr. ex A. Gray: 6; CO (6702), MO (6410); rip-ppw, ppw, mog-lac, rip, mog-rip; 1550–2350 m.

* *Lithospermum* aff. *multiflorum* Torr. ex A. Gray: 1; HA (5025); pmg, 1250–1300 m.

Mertensia franciscana A. Heller: 6; CO (5296); oaw-rip, mcw-rip, rip-ppw, rip, mog-lac; 1800–2400 m.

Mertensia lanceolata (Pursh) A. DC.: 10; CO (5239), MO (4720), UN (4193); mcw-rip, rip-ppw, mcw, mog, mog-rip, mcw-rip, rip-oaw, rds, pmg, oaw; 1800–2650 m.

Nama hispidum A. Gray: 3: CO (9049), QU (6987), SM (1291); mog-rip, rds, ari; 1150–2600 m.

Onosmodium molle Michx. var. *occidentale* (Mack.) I. M. Johnst.: 5; CO (7567), UN (6958); mog-lac, riw, pmg, ari; 1400–2300 m.

Phacelia alba Rydb.: 1; MO (6408); rip-ppw; 2300–2350 m.

Phacelia integrifolia Torr. var. *integrifolia*: 12; HA (4341), SM (6075), UN (3522); rip-pmg, pmg, rip, pal, mxs; 1300–1450 m.

Phacelia popei Torr. & A. Gray: 12; QU (4469), SM (3765); ari, rds, rip-pmg, pjw, bdl, rsl-pmg; 1150–1500 m.

Brassicaceae

! *Alyssum desertorum* Stapf: 1; CO (4666); rip-ppw; 1800–1850 m.

! *Alyssum parviflorum* M. Bieb. var. *micranthum* (C. A. Mey.) Dorn: 5; CO (3446), SM (NS-9864), UN (3462); rip, mcw, rds, pjw-oaw, pjw; 1900–2450 m.

Arabis hirsuta (L.) Scop. var. *pycnocarpa* (M. Hopkins) Rollins: 2; CO (6656); rip, ppw; 2000–2450 m.

! *Barbarea vulgaris* R. Br.: 5; CO (5263), MO (4726); mcw-rip, rip-ppw, rip, pmg-lac, mog-rip; 1550–2400 m.

Boechera fendleri (S. Watson) W. A. Weber: 1; SM (NS-9915); pjw-oaw; 2000–2050 m.

Boechera holboelii (Hornem.) var. *pinetorum* (Tidestr.) Dorn: 1; SM (NS-9847); rip; 1800–1850 m.

! *Camelina microcarpa* Andrz. ex DC.: 15; CO (5495), MO (6206), SM (4532), UN (1778); rds, lac, pmg, mog-lac, ppw, ari, pjw, oaw, rip-oaw; 1550–2300 m.

! *Capsella bursa-pastoris* (L.) Medik.: 10; CO (4706), MO (4724), SM (NS-9902), UN (5187); rip-ppw, oaw-rip, mcw, mog-rip, rip, mcw-rip, rds; 1700–2500 m.

! *Chorispora tenella* (Pall.) DC.: 2; UN (4241); rip-oaw, rds; 1900–2050 m. This may be more common than suggested here due to its early flowering.

! *Conringia orientalis* (L.) Dumort.: 1; UN (3470); rds; 2000–2050 m.

Descurainia incana (Bernh. ex Fisch. & C. A. Mey.) Dorn var. *incana*: 1; CO (7523); mog-lac; 2250–2300 m.

* *Descurainia* aff. *incana* (Bernh. ex Fisch. & C. A. Mey.) Dorn var. *incana*: 1; CO (7587); mog-lac; 2250–2300 m.

Descurainia incana (Bernh. ex Fisch. & C. A. Mey.) Dorn var. *incisa*: 3; CO (7884), SM (NS-9604), UN (1772); rip, rds; 1550–2000 m.

Descurainia pinnata (Walter) Britton *subsp. halictorum* (Cockerell) Detling: 46; CO (4294), HA (4619), MO (3155), QU (3655), SM (4793), UN (4244); lac, pmg, pmg-lac, mxs, rip-pmg, pmg-pjw, rds, rip, ari, oaw, pjw, rip-oaw, bdl,ppw; pjw-oaw; 1100–2050 m. [= *Descurainia pinnata* var. *osmiarum* (Cockerell) Shinners]

! *Descurainia sophia* (L.) Webb ex Prantl: 31; CO (5359), HA (3285), MO (4562), SM (4840), UN (5531); lac, pmg, rip-ppw, rds, pmg-lac, mxs, rip, ari, pjw, pmg-rip, riw, rip-oaw; 1150–2050 m.

Dimorphocarpa wislizeni (Engelm.) Rollins: 10; HA (4948), QU (4492), SM (8203); pmg, rip, ari, rds; 1150–1350 m.

Draba reptans (Lam.) Fernald: 1; UN (3213); pmg; 1550–1600 m.

Erysimum asperum (Nutt.) DC.: 51; CO (6634), HA (4599), MO (2230), SM (3931), UN (142); pmg, rip, oaw-rip, mog-lac, rds, fog, pmg-lac, ppw, pjw, pmg-rip, rsl, rip-oaw; 1400–2400 m.

* *Erysimum* aff. *asperum* (Nutt.) DC.: 1; CO (3398); pmg; 1800–1850 m.

Erysimum aff. *capitatum* (Douglas ex Hook.) Greene: 2; SM (8869), UN (1754); mxs, rds; 1850–2000 m.

Erysimum capitatum (Douglas ex Hook.) Greene var. *argillosum* (Greene) R.J. Davis: 5; CO (6739), MO (6368); rip-ppw, ppw, mog-rip; 2250–2600 m.

Erysimum capitatum (Douglas ex Hook.) Greene var. *capitatum*: 20; CO (5494), HA (727), MO (6335), SM (2300), UN (8003); rds, pmg, pmg-rip, oaw, fog; 1350–2300 m.

! *Erysimum repandum* L.: 2; MO (3149), UN (4221); rip, rip-oaw; 1550–1950 m.

Hesperidanthus linearifolius (A. Gray) Rydb.: 6; CO (9078), HA (1303), MO (6210), mog-rip, fog, pmg, pjw-row, mxs, ppw; 1500–2600 m. [= *Thelypodiopsis linearifolius* (A. Gray Al-Shehbaz]

* *Hesperidanthus* aff. *linearifolius* (A. Gray) Rydb.: 1; SM (4830); mxs; 1750–1800 m.

! *Hesperis matronalis* L.: 1; CO (5318); oaw-rip; 3350–2400 m.

Lepidium densiflorum Schrad. var. *densiflorum*: 28; HA (5024), MO (4563), SM (3696), UN (5642); pmg, mxs, pmg-pjw, pal, rip-pmg, mxs-lac, rds, rip, oaw, pjw, riw; 1250–2250 m.

!! *Lepidium draba* L: 5; MO (4727), UN (4240), SM (9935); rds, mog-rip, pjw, rip-oaw, rip; 1350–2400 m. [= *Cardaria draba* (L.) Desv.]

Lepidium ramosissimum A. Nelson var. *bourgeauanum* (Thell.) Rollins: 17; HA (6586), QU (3651), SM (3910), UN (3506); rip, pal, pmg-pjw, pmg, rip-pmg, bdl, ppw, rds; 1150–1750 m.

? *Lepidium ramosissimum* A. Nelson aff. var. *bourgeauanum* (Thell.) Rollins: 1; SM (NS-9678); ppw; 1200–1250 m.

Physaria fendleri (A. Gray) O'Kane & Al-Shehbaz: 10; QU (3667 B), SM (6069); ari, mxs, rds, rip-pmg, pjw, pmg, ppw; 1100–1500 m.

Physaria intermedia (S. Watson) O'Kane & Al-Shehbaz: 2; SM (4529); lac, rip; 1950–2000 m.

Physaria montana (A. Gray) O'Kane & Al-Shehbaz: 9; CO (4688), HA (4579), MO (3152), UN (4242); rip-ppw, oaw-rip; pmg-lac; mxs-lac; rip, rip-oaw, mcw-rip, rds, pmg; 1750–2400 m.

Physaria ovalifolia (Rydb.) O'Kane & Al-Shehbaz: 15; HA (4444), MO (3159), QU (4459), SM (NS-9664), UN (6826); pmg-pjw, pjw, pmg, rip-row, ari, pmg-rip, rds, rip-pmg, bdl, ppw; 1150–1800 m.

! *Nasturtium officinale* R. Br.: 4; SM (6269), UN (4234); rip-pmg, mcw-rip, rip-oaw, oaw; 1550–2250 m.

Noccaea fendleri (A. Gray) Holub: 8; CO (5260), SM (BR-7259), UN (NS-9304); rip, mcw-rip, mog-lac, ppw, mcw, pmg; 2200–2450 m.

Rorippa sinuata (Nutt.) Hitchc.: 7; CO (4274), MO (8566), UN (8566); lac, pmg-lac, pmg, rip, pmg-rip; 1550–1850 m.

SR *Rorippa teres* (Michx.) Stuckey: 1; MO (8792); rip; 2450–2500 m. The nearest known occurrences (Kartesz, pers. comm., 2008) are Coconino Co., AZ and Brewster and Wood counties, TX.

! *Sisymbrium altissimum* L.: 2; UN (3272); pmg, rds; 1550–2000 m.

Stanleya pinnata (Pursh) Britton var. *pinnata*: 1; CO (6789); rds; 1800–1850 m.

Thelypodium integrifolium (Nutt.) Endl. ex Walp. var. *integrifolium*: 3; HA (DH-12072), MO (DH-12106), UN (1595); pmg-pjw; 1600–1700 m.

Thelypodium wrightii A. Gray subsp. *wrightii*: 1; HA (8463), rip; 1450–1500 m. Specimen collected from sandy soil.

! *Thlaspi arvense* L.: 6; CO (6728), HA (5427), MO (3154), UN (4237; rip-ppw, mog-lac, mxs, rip, rip-oaw, oaw; 1600–2350 m.

Cactaceae

Coryphantha vivipara (Nutt.) Britton & Rose var. *arizonica* (Engelm.) W. T. Marshall: 2; HA (422), UN (5582); pmg, pmg-rip; 1400–1800 m.

Echinocereus coccineus Engelm. var. *coccineus*: 1; SM (3702), HA (NS-9524); pjw, pjw-pmg; 1700–1950 m.

Echinocereus fendleri (Engelm.) F. Seitz var. *fendleri*: 1; SM (3900), pjw; 1450–1500 m.

Echinocereus reichenbachii (Terscheck ex Walp.) F. Haage var. *perbellus* (Britton & Rose) L. D. Benson: 1; QU (NS-9681); pmg; 1150–1200 m.

Echinocereus viridiflorus Engelm. var. *viridiflorus*: 3; CO (4271), UN (3558); lac, rip-pmg; 1400–1850 m.

Opuntia engelmannii Salm-Dyck var. *engelmannii*: 3; CO (6490), SM (7031); ppw, mxs, ari; 1250–2050 m.

Orpuntia imbricata (Haw.) DC. var. *imbricata*: 7; HA (6588), SM (8151), UN (7335); rip, pjw, mxs, rip-pmg, pmg; 1400–1800 m. [*Cylindropuntia imbricata* (Haw.) Kunth var. *imbricata*]

? *Opuntia phaeacantha* Engelm.: 15; CO (7144), HA (4934), MO (6205), SM (5928), UN (5583); ari, pmg, rip-pmg, pmg-pjw, pal, mxs, ppw, rds, oaw; 1300–2250 m. Material inadquate for varietal determination; see next two entries.

Opuntia phaeacantha Engelm. var. *phaeacantha*: 6; CO (6767), HA (5004), UN (5650); rds, pmg, riw; 1350–1850 m.

Opuntia polyacantha Haw. var. *polyacantha*: 4; CO (6516), HA (5062) SM (6129); ppw, rip, rip-pmg, pmg; 1300–2350 m.

Campanulaceae

Campanula parryi A. Gray var. *parryi*: 1; CO (9046); mog-rip; 2550–2600 m.

Campanula rotundifolia L.: 7; CO (6626); rip, mog-rip, rds, ppw, mog-lac; 1550–2600 m.

Triodanis perfoliata (L.) Nieuwl.: 2; SM (6121); rip, rip-pmg; 1950–2250 m.

Cannabaceae

Celtis occidentalis L.: 5; HA (8323), UN (1207); pmg, rip, rds, rip-row; 1300–1650 m.

Celtis reticulata Torr.: 3; HA (NS-9459), UN (3574); rip-pmg, rds, rsl-riv; 1400–1600 m.

Humulus lupulus L. var. *neomexicanus* A. Nelson & Cockerell: 2; CO (7897), MO (8791); rip; 1550–2500 m.

Caprifoliaceae

! *Lonicera tatarica* L.: 1; SM (3368); pmg; 2000–2050 m. Specimen was collected from clay soil.

Symphoricarpos occidentalis Hook.: 5; CO (9092), MO (8820), UN (7984); mog-rip, rds, rip, oaw; 1550–2600 m.

* *Symphoricarpos* aff. *occidentalis* Hook.: 1; CO (7525); mog-lac; 2250–2300 m.

Valeriana arizonica A. Gray: 1; MO (3357); rip; 2450–2500 m

Valeriana edulis Nutt. ex Torr. & A. Gray var. *edulis*: 4; CO (6731), MO (4772); rip-ppw, mog-rip, mog-lac, lac; 2250–2450 m.

Caryophyllaceae

Cerastium brachypodum (Engelm. ex A. Gray) B. L. Rob.: 1; MO (4719); mog-rip; 2350–2400 m.

! *Cerastium fontanum* Baumg. subsp. *vulgare* (Hartm.) Greuter & Burdet: 1; CO (6697); rip-ppw; 2300–2350 m.

Cerastium nutans Raf. var. *nutans*: 2; MO (6333), SM (3695); rds, pjw; 1900–2300 m.

Eremogone fendleri (A. Gray) Ikonnikov: 8; CO (7414), MO (6183), SM (6111); ppw, rds, mog-lac, rip, mog-rip; 1550–2600 m. [=*Arenaria fendleri* A. Gray var. fendleri]

Minuartia michauxii (Fenzl) Farw. var. *texana* (B.L. Robins.) Mattf.: 1; HA (723); pmg; 1750–1800 m.

Paronychia depressa (Torr. & A. Gray) Nutt. ex A. Nelson: 1; UN (1956); rds; 1700–1750 m.

Paronychia jamesii Torr. & A. Gray: 7; HA (8618), QU (2685), SM (8192), UN (2904); pmg, mxs, rds; 1150–1850 m.

Paronychia sessiliflora Nutt.: 6; HA (8617), UN (2130); pmg, pmg-rip, rsl, fog; 1350–1900 m.

Pseudostellaria jamesiana (Torr.) W. A. Weber & R. L. Hartm.: 1; CO (5247); mcw-rip; 2250–2300 m.

Silene antirrhina L.: 1; SM (6162); rip; 1950–2000 m.

! *Silene latifolia* Poir.: 2; CO (7555); mog-lac, oaw-rip; 2250–2400 m.

Silene scouleri Hook. subsp. *hallii* (S. Watson) C. L. Hitchc.: 1; CO (9064); mog-rip; 2550–2600 m.

Ceratophyllaceae

Ceratophyllum demersum L.: 1; UN (7378); ari; 1550–1600 m.

Cleomaceae

Cleome serrulata Pursh: 4; UN (8681); pmg-rip, rip, rip-row; 1350–1550 m.

Polanisia dodecandra (L.) DC. var. *trachysperma* (Torr. & A. Gray) H. H. Iltis: 15; HA (6576), MO (7701), UN (7637); rip, pmg, pmg-rip, fog, rds, rip-row; 1350–1750 m.

Commelinaceae

Commelina erecta L.: 18; HA (3086), MO (DH-12215), SM (8132), UN (2982); mxs, rip, pmg-rip, rds, pmg, pmg-pjw, rip-row; 1350–1900 m.

Tradescantia occidentalis (Britton) Smyth: 25; HA (4944), QU (3654), SM (8873), UN (5734); pmg, rip, rds, mxs, rip-pmg, riw, pmg-rip, riw, pmg-pjw; 1150–1900 m.

Convolvulaceae

Calystegia sepium (L.) R. Br. var. *angulata* (Brummitt) N. H. Holmgren: 1; SM (3903); pjw; 1450–1500 m.

!! *Convolvulus arvensis* L.: 58; CO (5342), HA (4596), MO (8560), SM (4518), UN (5735); lac, oaw-rip, rds, lac, pmg, mog-lac, ari, fog, ppw, pmg-lac, rip, ppw, fog-ari, rip-pmg, pjw, riw, oaw; 1300–2500 m.

Convolvulus equitans Benth.: 21; HA (4306), SM (5933), UN (7633); pmg, pjw, rip, rds, rip-pmg, pmg-pjw, row, rip-row; 1350–1750 m.

* *Cuscuta* aff. *cuspidata* Engelm.: 1; UN (2948); pmg; 1450–1500 m.

* *Cuscuta* aff. *indecora* Choisy: 2; HA (8322), UN (1957); pmg, rds; 1300–1750 m.

Cuscuta umbellata Kunth: 1; UN (DH-11811); 1500–1550 m.

Evolvulus alsinoides (L.) L.: 2; UN (998); pmg, 1450–1550.

Evolvulus nuttallianus Schult.: 16; HA (5003), MO (8589), SM (3896), UN (5549); pmg, rip, pjw, rip-pmg, riw, pmg-rip; 1250–1750 m.

Ipomoea barbatisepala A. Gray: 1; MO (DH-12189); rip; 1500–1600 m.

Ipomoea cristulata Hallier f.: 1; HA (DH-1218); rip; 1500–1600 m.

Ipomoea leptophylla Torr.: 34; HA (6611), MO (8575), QU (6991), SM (8200), UN (7711); rip, mxs, pjw, pmg, rip-pmg; 1150–1800 m.

Cornaceae

Cornus sericea L. var. *sericea*: 1; CO (7899); rip; 1550–1600 m.

Crassulaceae

Sedum integrifolium (Raf.) A. Nelson: 1; CO (6669); rip; 2400–2450 m.

Cucurbitaceae

Cucurbita foetidissima Kunth: 28; HA (6573), MO (7842), QU (2711), SM (6015), UN (171); rip, pmg, rds, mxs, rip-pmg, riw, ari, fog; 1300–2000 m.

Cyclanthera dissecta (Torr. & A. Gray) Arn.: 2; SM (8129); pmg-rip; 1400–1450 m.

Cyperaceae

Bolboschoenus maritimus (L.) Palla subsp. *paludosus* (A. Nelson) A. Löve & D. Löve: 6; CO (9024), HA (DH-12062), MO (7848), SM (8982), UN (7395); lac, pmg, fog-ari, 1500–2050 m.

Carex aquatilis Wahlenb. var. *aquatilis*: 1; CO (5276 A); mcw-rip; 2250–2300 m.

Carex brevior (Dewey) Mack. ex Lunell: 6; CO (7608), HA (5473), SM (6174), UN (5808); mog-lac, rip, rip-pmg, mcw-rip; 1300–2300 m.

Carex emoryi Dewey: 3; CO (5276 B), SM (9852), UN (4264); mcw-rip, rip-oaw, rip; 1800–2300 m.

Carex gravida L. H. Bailey var. *lunelliana* (Mack.) F. J. Herm.: 4; MO (4758), UN (6811); mog-rip, ari; 1550–2400 m.

Carex hystricina Muhl. ex Willd.: 1; UN (8066 A); oaw; 1550–1600 m.

Carex pellita Muhl. ex Willd.: 8; CO (6750), HA (5476), MO (4760), UN (3251); rip-ppw, mog-lac, ppw, mog-rip, rip, ari; 1550–2500 m. [=*Carex lanuginosa* Michx.]

Carex nebrascensis Dewey: 1; MO (6388), rip-ppw; 2300–2350 m.

Carex occidentalis L. H. Bailey: 12; CO (5321), SM (3755), UN (4265); oaw-rip, pmg, rip-ppw, rip, ppw, pjw, rip-pmg, mcw-rip, oaw; 1550–2450 m.

* *Carex* aff. *occidentalis* L. H. Bailey: 1; CO (5360); lac; 1800–1850 m.

Carex inops Bailey subsp. *heliophila* (Mackenzie) Crins 4; CO (6504), MO (4765); mcw, ppw, lac, rip-ppw; 2000–2450 m. [=*Carex pensylvanica* Lam. var. *digyna* Boeck]

* *Carex* aff. *inops* Bailey subsp. *heliophila* (Mackenzie) Crins.: 1; MO (4764); lac; 2400–2450 m.

Carex petasata Dewey: 2; UN (5162); mcw-rip, ari; 1550–1600 m.

Carex praegracilis Boott: 1; HA (DH-11664); 1750–1800 m.

Carex siccata Dewey: 1; CO (6749); rip-ppw; 2300–2350 m.

Carex sprengelii Dewey ex Spreng.: 1; CO (3443); mcw; 2400–2450 m.

Carex stenophylla Wahlenb.: 6; CO (4710), MO (3359), UN (5148); rip-ppw, rip, mcw, mog-rip, mcw-rip; 1550–2500 m.

Carex utriculata Boott: 1; MO (8857 A); rip; 2450–2500 m.

Carex vulpinoidea Michx.: 7; HA (5472), MO (8503), SM (8983), UN (8071); rip, ppw-pjw, fog-ari, ari, oaw; 1550–2050 m.

Cyperus erythrorhizos Muhl.: 3; HA (4926); UN (7387); pmg, ari; 1300–1600 m.

Cyperus esculentus L. var. *leptostachys* Boeck.: 1; MO (8569); rip; 1550–1600 m.

Cyperus odoratus L.; 1; MO (DH-12214); rip; 1550–1650 m.

Cyperus schweinitzii Torr.: 10; HA (8357), MO (DH-12197), UN (7324); rip, mxs, rip-pmg, pmg; 1300–1750 m.

Cyperus squarrosus L.: 1; HA (DH-12213); rip, rsl; 1500–1700 m.

* *Eleocharis* aff. *obtusa* (Willd) Schult.: 1; UN (1629); pmg-pjw; 1650–1700 m.

Eleocharis palustris (L.) Roem. & Schult.: 52; CO (5332), HA (4616), MO (4759), SM (6171), UN (4263); lac, mcw-rip, rip, mog-lac, ppw, mog-rip, pmg-lac, pmg-pjw, pmg, ppw-pjw, mxs-lac, rip-ppw, ari, fog-ari, oaw; 1300–2600 m.

Eleocharis parvula (Roem. & Schult.) Link ex Bluff & Fingerh.: 1; CO (9038); lac; 1800–1850 m. [=*Eleocharis coloradoensis* (Britt.) Gilly]

Schoenoplectus acutus (Muhl. ex Bigelow) A.Löve & D. Löve var. *acutus*: 3; CO (9006), HA (DH 12125), SM (8964 B); lac, fog-ari; 1600–2050 m. Reported but not evidently confirmed for NM, if correct these specimens will confirm its presence.

? *Schoenoplectus pungens* (Vahl) Palla var. aff. *pungens*: 29; HA (5469), MO (8498) QU (NS-9798), SM (3874), UN (5744); rip, pal, pmg-rip, pmg, ari, riw; rds; 1300–2050 m. More recent information suggests these are probably variety *longispicatus* (Britt.) S. G. Sm., since var. *pungens* is not known from NM or adjacent states.

Schoenoplectus tabernaemontani (K. C. Gmel.) Palla: 17; CO (5364), HA (5464), MO (8539), QU (4506), SM (6167), UN (4266); lac, rip, ppw-pjw, rip-ppw, ari, fog-ari, pmg-rip, mcw-rip, oaw-rip, oaw; 1150–2350 m.

Scirpus pallidus (Britton) Fernald: 6; CO (8782), HA (5474), MO (8847), UN (8068); rds, mog-lac, rip, ppw-pjw, rip, oaw; 1550–2500 m.

Elaeagnaceae

!! *Elaeagnus angustifolia* L.: 3; QU (NS-9706), SM (6018); mxs, fog-ari, pmg; 1150–2050 m.

Euphorbiaceae

Argythamnia mercurialina (Nutt.) Müll. Arg.: 1; UN (7693); rip-pmg; 1450–1500 m.

Chamaesyce fendleri (Torr. & A. Gray) Small: 23; HA (5073), MO (7808), QU (2673), SM (8909), UN (5540); rds, pmg, mxs, rip, pmg-rip, pmg-pjw, rsl-riw, ppw; 1300–2000 m.

Chamaesyce geyeri (Engelm.) Small: 1; UN (2485), rip-row; 1350–1400 m.

Chamaesyce glyptosperma (Engelm.) Small: 1; HA (8385); rip; 1450–1500 m. Specimen collected from sandy soil.

Chamaesyce lata (Engelm.) Small: 6; HA (7189), QU (NS-9734), SM (6065), UN (6945); pmg, mxs, rds; 1150–1650 m.

Chamaesyce missurica (Raf.) Shinners: 12; HA (8237), UN (7624); pmg, rip-pmg; 1300–1700 m.

Chamaesyce serpyllifolia (Pers.) Small: 3; HA (7726), MO (8564); pjw, rip; 1550–1791 m.

Chamaesyce stictospora (Engelm.) Small: 2; HA (DH-11656), UN (2746); rds; 1300–1850 m.

Croton texensis (Klotzsch) Müll. Arg.: 37; HA (8320); QU (2669); SM (5994); UN (2101); pmg, rip-pmg, mxs, rds, ari, pmg-rsl, rip, rip-row; 1150–1600 m.

Euphorbia brachycera Engelm.: 2; HA (DH-11784), UN (9334); mxs; 1600–2000 m.

SR *Euphorbia dentata* Michx. var. *dentanta*: 20; HA (6602), MO (7814), QU (2667), SM (8948), UN (1637); rip, rip-pmg, rds, fog-ari, rsl, pmg-rsl, rip-row; 1300–2050 m. As best we can determine our report is a state record and represents a southwestward expansion of the nearest portion of the range from southeastern CO (Las Animas and Baca cos.) and Cimarron Co., OK.

Euphorbia marginata Pursh: 24; HA (8634), MO (8577), UN (7626); pmg, pjw, rip, rip-pmg, ari, rds, fog, row, pmg-rsl, pmg-pjw, rip-row; 1300–1850 m.

Euphorbia spathulata Lam.: 9; HA (4402), QU (NS-9793), SM (5939); pmg-pjw, rds, pjw, pmg, rsl-pmg, ppw; 1150–1450 m.

~ *Euphorbia strictior* Holz.: 4; HA (5064), SM (8202); pmg; 1150–1350. Most specimens collected from sandy soil.

Stillingia sylvatica Garden ex L. subsp. *sylvatica*: 6; HA (5038), UN (982); pmg; 1250–1600 m. Specimens collected from sandy soils.

Tragia ramosa Torr.: 6; HA (6551), MO (8506), QU (NS-9725), UN (5591); rip, mxs, pmg-rip, riw, pmg; 1150–1600 m.

Fabaceae

Amorpha canescens Pursh: 5; HA (4401), MO (6381), SM (6300), UN (8014); pmg-pjw, rip-ppw, rip-pmg, ari, oaw; 1400–1350 m.

Amorpha fruticosa L.: 3; SM (8127); pmg-rip; 1400–1450 m.

Astragalus adsurgens Pall. var. *robustior* Hook.: 3; MO (6198), UN (4252); ppw, rds, rip-oaw; 1900–2200 m. [=*A. laxmannii* Jacq. var. *robustior* (Hook.) Barneby & Welsh]

Astragalus agrestis Douglas ex G. Don: 3; CO (5246), UN (5199); mcw-rip, pmg; 1800–2300 m.

Astragalus bisulcatus (Hook.) A. Gray var. *bisulcatus*: 10; CO (5330), HA (4614), SM (4523), UN (5200); pmg, lac, pmg-lac, mcw-rip; 1500–1850 m.

Astragalus crassicarpus Nutt. var. *crassicarpus*: 5; HA (5055), SM (NS-9936), UN (3511), pmg, rds; 1300–1850 m.

Astragalus drummondii Douglas ex Hook.: 2; CO (7504), UN (4243); mog-lac, rip-oaw; 1900–2300 m.

Astragalus gracilis Nutt.: 2; CO (5128), UN (3495); rds, pmg; 1500–1900 m.

Astragalus hallii A. Gray var. *hallii*: 2; UN (4251); rip-oaw, oaw; 1550–1950 m.

Astragalus lentiginosus Douglas ex Hook. var. *albiflorus* M. E. Jones: 2; SM (3904); ppw, pjw; 1200–1500 m.

Astragalus lotiflorus Hook.: 3; HA (DH-11763), SM (NS-9927), UN (3205 B); pmg, pjw; 1800–1950 m.

Astragalus missouriensis Nutt. var. *missouriensis*: 30; CO (5487), HA (4611), MO (3161), QU (NS-9817), SM (4515), UN (3252); rds, pmg-lac, pmg, pmg-pjw, rip, mxs-lac, rip-row, lac, pjw, pmg-rip, mxs, ari; 1400–2050 m.

Astragalus mollissimus Torr. var. *mollissimus*: 33; HA (5842), QU (3675), SM (3836), UN (6820); pmg, pmg-pjw, rip, ari, oaw, pmg-rip, riw, rip-row, rds, rsl-riw, bdl, pjw; 1150–2000 m.

Astragalus nuttallianus DC. var. *austrinus* (Small) Barneby: 3; QU (NS-9700), SM (NS-9926); pmg, rds, pjw; 1150–1950 m.

Astragalus puniceus Osterh. var. *puniceus*: 1; CO (9060); mog-rip; 2550–2600 m.

* *Astragalus* aff. *racemosus* Pursh: 1; HA (DH-11750); 1850–1900 m.

Astragalus racemosus Pursh var. *racemosus*: 6; CO (5267), SM (4850), UN (3545); mcw-rip, rds, pmg, oaw; 1350–2300 m.

~ *Astragalus shortianus* Nutt.: 1; UN (3478); rds; 1500–1550 m.

Astragalus tenellus Pursh: 1; HA (4615); pmg-lac; 1800–1850 m. Specimen collected from sandy soil.

~ *Astragalus wittmannii* Barneby: 1; HA (DH-11709), pmg; 1800–1850 m. Collected from limestone substrate.

Dalea aurea Nutt. ex Pursh: 15; HA (8426), UN (6967), rip, pmg, rip-pmg, ari, pmg-rsl, rsl, rds; 1350–1700 m.

* *Dalea* aff. *candida* Michx.: 1; UN (2358); rds; 1400–1450 m.

Dalea candida Michx. var. *oligophylla* (Torr.) Shinners: 31; CO (7929), HA (3042), MO (7837), QU (2684), SM (8181), UN (7334); rip, pjw, pmg, rip-pmg, mxs, ari, rds, oaw, pmg-rsl, fog, rip-row; 1350–2050 m.

Dalea enneandra Nutt.: 9; HA (8358), MO (7819), QU (7006), SM (8194), UN (2505); rip, pmg, rds, rip-pmg, rsl, rip-row; 1150–1600 m.

Dalea formosa Torr.: 14; HA (NS-9470), QU (4482), SM (9649); ari, mxs, oaw, pjw, rsl-riw, pjw-pmg, rsl-pmg, pmg, ppw, rds; 1100–1800 m.

Dalea jamesii (Torr.) Torr. & A. Gray: 13; HA (4395), SM (4851), UN (1567); pmg-pjw, pmg, rip, mxs, rds, oaw, pjw, pmg-rip, rsl-riw; 1250–2000 m.

Dalea lanata Spreng. var. *lanata*: 1; HA (8369), rip; 1300–1350 m.

Dalea nana Torr. var. *carnescens* (Rydb.) Kearney & Peebles: 1; HA (3063 B); mxs; 1500–1550. Collected from a rocky substrate.

Dalea nana Torr. & A. Gray var. *nana*: 4; HA (8256); UN (2845); pmg, rip-pmg; 1300–1550 m.

Dalea purpurea Vent. var. *arenicola* (Wemple) Barneby: 10; CO (6766), HA (7219), UN (1883); rds, pmg, mxs, rip-pmg; 1350–1850 m.

* *Dalea* aff. *purpurea* Vent.: 3; HA (451), UN (1095); ppw-pjw, pmg, rds; 1350–1850 m.

Dalea purpurea Vent. var. *purpurea*: 19; CO (5479), HA (5090), QU (4496), SM (3922), UN (1597); rds, pmg, pmg-pjw, ari, mxs, pjw, pmg-rip, oaw; 1300–2500 m.

? *Dalea purpurea* Vent. aff. var. *purpurea*: 1; UN (3994); rds; 1550–1600 m.

Dalea tenuifolia (A. Gray) Shinners: 10; HA (8455), MO (8515), QU (6979), SM (5996), UN (6849); rip, pmg, ppw-pjw, rds, mxs, ari; 1150–1850 m.

Dalea villosa (Nutt.) Spreng. var. *villosa*: 1; UN (1017); pmg; 1500–1550 m.

Desmanthus cooleyi (Eat.) Trel.: 20; HA (8386), MO (7835), QU (6999), SM (6002), UN (7715); rip, pmg, mxs, ari, rds, rip-pmg; 1250–2000 m.

Desmanthus illinoensis (Michx.) MacMill. ex B. L. Rob. & Fernald: 1; UN (2441); rip; 1350–1400 m.

! *Gleditsia triacanthos* L.: 2; HA (529), UN (2401); pjw, rip; 1350–1600 m.

Glycyrrhiza lepidota Nutt. ex Pursh: 17; CO (6756), HA (4904), MO (8836), SM (7118), UN (5673); rip, mog-lac, pmg, pal, rip-ppw, ari, rip-pmg, riw, oaw; 1300–2250 m.

Hedysarum boreale Nutt. var. *boreale*: 4; HA (5463); rip, pmg, pjw-mxs; 1600–1850 m.

Hoffmanseggia glauca (Ortega) Eifert: 10; HA (4398); SM (5924); UN (2069); pmg-pjw, rip-pmg, rds, pmg-rsl, pmg; 1300–1450 m.

Lathyrus eucosmus Butters & H. St. John: 9; CO (7545), MO (8591), SM (4810), UN (4095); mog-lac, rip, oaw, rip-pmg, pjw, rds, rds-riw; 1600–2250 m.

Lathyrus graminifolius (S. Wats.) White: 2; CO (4679), MO (4738); rip-ppw, mog-rip; 1800–2400 m.

Lathyrus lanszwertii Kellogg var. *leucanthus* (Rydb.) Dorn.: 2; CO (5279), UN (4239); mcw-rip, rip-oaw; 1900–2300 m. The taxon boundaries of this and others were discussed for NM by Johnson & Allred 2003).

Lathyrus polymorphus Nutt. var. *incanus* (J. G. Sm. & Rydb. ex Rydb.) Dorn: 1; UN (3205 A), pmg; 1550 –1600 m.

Lupinus argenteus Pursh var. *argenteus*: 2; CO (7515); mog-lac, rds; 2250–2350 m.

Lupinus argenteus Pursh var. *argophyllus* (A. Gray) S. Watson: 3; CO (8772), UN (NS-9310); rds, ppw; 2200–2500 m.

Lupinus plattensis S. Watson: 7; CO (5133), HA (5878), UN (5575); rds, pmg-lac, fog, pmg, pmg-rip; 1350–2000 m.

Lupinus pusillus Pursh var. *pusillus*: 3; HA (5387), MO (3145); mxs, rip; 1550–1600 m.

! *Medicago lupulina* L.: 31; CO (4705), HA (5451), MO (4730), SM (8937), UN (4232); rip, rip-ppw, mcw-rip, mog-lac, ppw, mog-rip, ppw, ppw-pjw, mxs-lac, mog-rip, lac, rds, fog-ari, pmg-rip, pjw, pmg, mcw-rip, rip-oaw, oaw; 1400–2500 m.

! *Medicago polymorpha* L.: 1; CO (5488), rds; 1900–1950 m.

! *Medicago sativa* L.: 13; CO (6784), HA (5460), MO (8834), SM (7070), UN (705); rds, ari, rip, pjw, oaw; 1350–2500 m.

! *Melilotus albus* Medik.: 35; CO (8998), HA (6604), MO (8565), SM (8918), UN (7323); lac, rip, rip-pmg, ppw-pjw, pjw, pmg, mxs, ari, rds, pmg, pmg-pjw, fog, rip-row; 1300–2500 m.

! *Melilotus officinalis* (L.) Pall.: 79; CO (5516), HA (4323), MO (4546), QU (4501), SM (6049), UN (5237); rds, lac, rip-ppw, pmg, ari, mog-lac, ppw, mog-rip, fog, pmg-lac, mxs, rip, pjw, ppw-pjw, fog-ari, rip-pmg, oaw; 1150–2500 m.

Mimosa aculeaticarpa Ortega var. *biuncifera* (Bentham) Barneby: 3; HA (4954 B), UN (861); pmg, rds; 1300–1400 m.

Mimosa borealis A. Gray: 6; HA (5032), QU (4483), SM (NS-9648), UN (2135); pmg, ari, riw, rsl, ppw; 1150–1400 m.

Oxytropis lambertii Pursh var. *bigelovii* A. Gray: 11; CO (5124), HA (5057), UN (3208); rds, rip-ppw, ppw, rip, pmg; 1300–1900 m.

Oxytropis lambertii x *Oxytropis sericea*: 1; CO (9114); mog-rip; 2550–2600 m.

Oxytropis sericea Nutt. var. *sericea*: 9; CO (5358), HA (3291), MO (6242 B), SM (7125); lac, rip-ppw, mog-rip, rds, ari, mcw-rip, pmg; 1700–2600 m.

Pediomelum argophyllum (Pursh) J. W. Grimes: 2; CO (7550), UN (7975); mog-lac, oaw; 1550–2300 m.

Pomaria jamesii (Torr. & A. Gray) Walp.: 16; HA (4312), QU (NS-9716), SM (8195), UN (6870); pmg, rip, pmg-rip, rds; 1100–1550 m.

Prosopis glandulosa Torr. var. *glandulosa*: 13; HA (6565), QU (4489), SM (6001); rip, pmg, rip-pmg, mxs; ari, rds; 1150–1600 m.

Psoralidium lanceolatum (Pursh) Rydb.: 6; CO (6474), HA (4985), UN (237); ppw, rip, mxs, pmg-rip, pmg; 1350–2050 m.

Psoralidium tenuiflorum (Pursh) Rydb.: 76; CO (7472), HA (5915), MO (6241), QU (2701), SM (8917), UN (7307); ppw, lac, fog, pmg, pjw, rip, mxs, rds, ari, rip-pmg, riw, oaw, pmg-rsl, rsl, row, rip-row; 1250–2000 m.

Robinia neomexicana A. Gray var. *neomexicana*: 11; CO (5327), HA (5399), MO (3139), UN (8060); oaw-rip, mog-lac, rds, ppw, mxs, rip, oaw; 1450–2350 m.

! *Robinia pseudoacacia* L.: 2; HA (510), UN (2862); pjw, pmg; 1400–1600 m.

Senna roemeriana (Scheele) Irwin: 6; SM (5930); rds, mxs, ari; 1250–1500 m.

Sophora nuttalliana B. L. Turner: 40; CO (4640), HA (4396), MO (4551), QU (4467), SM (6155) UN (5755); pmg, lac, pmg-pjw, rip-pmg, mxs, pmg-lac, rip, pjw, mxs-lac, rds, rip-row, ari, fog-ari, riw; 1150–2050 m.

Thermopsis montana Nutt. var. *divaricarpa* (A. Nelson) Dorn: 1; UN (4261); rip-oaw; 1900–1950 m.

Thermopsis montana Nutt. var. *montana* : 7; CO (4703), MO (4774); rip-ppw, mcw-rip, ppw, mog-lac, mog-rip, lac, oaw; 1800–2600 m.

! *Trifolium pratense* L.: 6; CO (6648), MO (8813), rip, mog-lac, mog-rip, rds, rip-ppw; 2250–2600 m.

! *Trifolium repens* L.: 7; CO (7556), MO (8814), UN (5146); rip, mog-lac, mog-rip, rip-ppw, mcw-rip; 1550–2500 m.

Vicia americana Muhl. ex Willd. var. *americana*: 9; CO (6718), MO (8793), UN (5201); rip-ppw, rip, mcw-rip, ppw, mog-lac; 1800–2500 m.

Vicia americana Muhl. ex Willd. var. *minor* Hook.: 21; CO (4642), MO (4773), SM (6150), UN (1720); pmg, lac, ppw, mog-rip, rds, rip-ppw, ppw, rip, rip-pmg, pmg-pjw, rip-oaw, pjw-oaw; 1600–2450 m.

Vicia ludoviciana Nutt. var. *ludoviciana*: 12; CO (4301), HA (4584), SM (3793), UN (4130); lac, pmg, pmg-lac, rip-pmg, pmg-pjw, rds, mxs-lac, pjw; 1350–1950 m.

Fagaceae

Quercus gambelii Nutt: 21; CO (6442), HA (9491), MO (4725), SM (9839), UN (8059); fog, rip-ppw, oaw-rip, rip-mcw, rds, mog-lac, rip, ppw, mog-rip, rip-ppw, oaw; 1550–2500 m.

Quercus grisea Liebm.: 6; HA (4411), MO (4550), SM (8892), UN (5726); pmg-pjw, mxs, rds, riw, rip; 1350–1900 m.

Quercus X *undulata* Torr.: 23; HA (5459), MO (6207), SM (4792), UN (1753); rip, pjw-row, ppw-pjw, lac, ppw, rip-row, oaw, mxs, rip-pmg, pjw, riw, rds, pmg-pjw, rsl-riv; 1350–2400 m.

* *Quercus* aff. X *undulata* Torr.: 2; HA (3312), SM (3708); mxs-lac, pjw; 1750–1950 m.

Gentianaceae

Centaurium calycosum (Buckley) Fernald; 2; HA (7241), MO (DH-11731); rip-pmg; 1350–1400 m. [=*Zeltnera calyca* (Buckley) Mansion]

Frasera speciosa Douglas ex Griseb.: 3; CO (7581); mog-lac, ppw, oaw; 1550–2350 m.

Gentiana parryi Engelm.: 1; HA (8326); pmg; 1300–1350. Specimen collected from sandy soil.

Gentianopsis detonsa (Rottb.) Ma var. *elegans* (A. Nelson) N. H. Holmgren: 1; CO (9056); mog-rip; 2550–2600 m.

Geraniaceae

! *Erodium cicutarium* (L.) L'Hér. ex Aiton: 23; CO (4681), HA (4605), MO (6211), SM (3721), UN (1438); rip-ppw, mcw; pmg-lac, mxs, ppw, mxs-lac, rds, rip, lac, ari, fog-ari, pjw, rip-pmg, pmg, pjw-pmg; 1550–2450 m.

Geranium atropurpureum A. Heller var. *atropurpureum*: 5; CO (6734), MO (8818), UN (9324); rip-ppw, rip, rds, ppw; 2150–2500 m.

Geranium caespitosum E. James var. *caespitosum*: 9; CO (6658), UN (7993); rip, ppw, mog-lac, rds, mog-rip, oaw; 1550–2600 m.

Geranium richardsonii Fisch. & Trautv.: 2; CO (6659); rip, mog-rip; 2400–2600 m.

Grossulariaceae

Ribes aureum Pursh var. *aureum*: 3; UN (6846); ari, rip-oaw; 1550–1950 m.

Ribes cereum Douglas: 7; CO (4674), UN (3255); rip-ppw, mog-rip, mcw, mcw-rip, rds, ari, ppw; 1600–2600 m.

Ribes leptanthum A. Gray: 4; CO (3427), SM (6122), UN (4213); mcw, rip, rip-oaw, oaw; 1900–2450 m.

Hydrangeaceae

Jamesia americana Torr. & A. Gray var. *americana*: 1; CO (6630); rip; 2400–2450 m.

Philadelphus microphyllus A. Gray: 1; CO (7912); rip; 1550–1600 m.

Hypericaceae

Hypericum perforatum L.: 1; CO (7583); mog-lac; 2250–2300 m.

Iridaceae

Iris missouriensis Nutt.: 11; CO (5298), HA (4624), MO (4735), SM (NS-9897); oaw-rip, mcw-rip, pmg, rip-ppw, ppw, mcw; pmg-lac, mog-rip, oaw, rds; 1700–2450 m.

Sisyrinchium demissum Greene: 4; CO (5287), UN (5142); oaw-rip, rip, mcw-rip, pmg-rip; 1500–2450 m.

* *Sisyrinchium* aff. *montanum* Greene: 1; MO (4768), lac; 2400–2450 m.

Juncaceae

Juncus arcticus Willd. var. *balticus* (Willd.) Trautv.: 24; CO (4282), HA (4949), MO (4757), SM (7078), UN (4262); lac, mcw-rip, pmg, rip-ppw, rip, ari, mog-lac, ppw, mog-rip, pal, pjw, oaw, rds, pmg-rip, rip-oaw; 1300–2600 m.

Juncus bufonius L.: 1; MO (8596); rip; 1550–1600 m.

Juncus dudleyi Wiegand: 5; CO (7483), HA (476), MO (8859), UN (5633); ppw, ppw-pjw, rip, pmg-rip; 1400–2500 m.

Juncus effusus L.: 1; SM (3751 A); pjw; 1900–1950 m.

Juncus ensifolius Wikstr. var. *montanus* (Engelm.) C. L. Hitchc.: 6; CO (7612), MO (8860), SM (6320); ppw, mog-lac, mog-rip, rip, rip-pmg; 2200–2600 m.

Juncus filiformis L.: 2; CO (5329), UN (3262); oaw-rip, ari; 1550–2400 m.

Juncus interior Wiegand: 7; HA (5454), MO (8504), SM (6303), UN (3603); rip, pjw, pjw-row, rip-pmg; 1400–2200 m.

Juncus longistylis Torr.: 2; CO (9146); ppw, mog-rip; 2250–2600 m.

Juncus nodosus L.: 1; CO (7412), HA (DH-11718), UN (8067); ppw, oaw; 1550–2300 m.

Juncus tenuis Willd.: 1; UN (7384); ari; 1550–1600 m.

Juncus torreyi Coville: 8; HA (7251), MO (8502), UN (7689); rip-pmg, rip, ari; 1300–1600 m.

Luzula comosa E. Mey.: 1; CO (6639); rip; 2400–2450 m.

Lamiaceae

Dracocephalum parviflorum Nutt.: 6; CO (7564), MO (8724), SM (6113); mog-lac, rds, rip, rip-ppw; 1950–2500 m.

Hedeoma drummondii Benth.: 2; HA (8610), SM (8877); pmg, mxs; 1800–1900 m.

! *Marrubium vulgare* L.: 16; CO (7876), HA (4977), MO (6195), SM (6310), UN (1201); rip, pmg-lac, pmg, mxs, rds, ppw, rip-pmg, ari, oaw; 1300–2200 m.

Mentha arvensis L.: 8; CO (7527), HA (8309), MO (8794), UN (8037); mog-lac, mog-rip, ppw, pmg, rip, oaw; 1300–2600 m.

Monarda fistulosa L. var. *menthifolia* (Graham) Fernald: 4; CO (7566), mog-lac, ppw, rip, rds; 1550–2350 m.

Monarda pectinata Nutt.: 15; HA (4359), MO (6338), QU (4497), SM (5995), UN (5699); rip-pmg, rds, ari, rip-pmg, riw, pmg; 1100–2300 m.

Monarda punctata L. var. *occidentalis* (Epling) Palmer & Steyerm.: 2; HA (5067); pmg, rip; 1300–1350 m.

Prunella vulgaris L.: 3; CO (6709); rip-ppw, rip, ppw; 2250–2450 m.

Salvia reflexa Hornem.: 17; HA (3077), MO (8530), SM (8955), UN (1203); mxs, rip, fog-ari, pmg, rds, rip-pmg, row, pmg-pjw; 1300–2050 m.

Stachys pilosa Nutt. var. *pilosa*; 2; CO (7875); rip, ppw;1550–2300 m. These specimens were misidentified originally as *S. palustris* L., which occurs in the northcentral and northeastern US.

Teucrium laciniatum Torr.: 36; HA (5904), MO (2231), QU (4462), SM (6094), UN (5555); pmg, pmg-pjw, mxs, rip, rds, ari, pjw, pmg-rip, riw, oaw; 1150–2200 m.

Liliaceae

Calochortus gunnisonii S. Watson var. *gunnisonii*: 1; CO (7529); mog-lac; 2250–2300 m.

& *Calochortus gunnisonii* S. Watson var. *perpulcher* Cockerell: Not collected but known from study area in Colfax, Mora and San Miguel counties (Tables 10, 11).

Linaceae

Linum aristatum Engelm.: 2; SM (3808), UN (5731); rip-pmg, riw; 1400–1450 m.

Linum berlandieri Hook. var. *berlandieri*: 1; UN (5206); pmg; 1450–1500 m.

Linum lewisii Pursh var. *lewisii*: 38; CO (4298), HA (4592), MO (8789), SM (4509), UN (4245); lac, rip-ppw, rds, ppw, mog-rip, pmg-lac, pmg, mxs-lac, rip, ari, rip-pmg, rip-oaw, row, pjw-pmg, pjw; 1350–2600 m.

Linum pratense (Norton) Small: 1; QU (NS-9808); pmg; 1400–1450 m.

Linum puberulum (Engelm.) A. Heller: 12; HA (4594), MO (2240), QU (NS-9780), SM (3891), UN (3560); pmg-lac, rip, pmg, rds, mxs, pjw; 1150–1950 m.

Linum rigidum Pursh var. *compactum* (A. Nelson) C. M. Rogers: 7; CO (6433), HA (5837), QU (NS-9790), UN (354); 1300–2000 m.

Linum rigidum Pursh var. *rigidum*: 4; MO (6199), SM (7094), UN (6956); ppw, ari, rip-pmg, pmg; 1450–2200 m.

Loasaceae

Cevallia sinuata Lag.: 1; QU (7005), ari-rds; 1150–1200 m.

Mentzelia decapetala (Pursh ex Sims) Urb. & Gilg ex Gilg: 2; MO (8604), UN (2161); rip, rsl; 1350–1600 m.

* *Mentzelia* aff. *multiflora* (Nutt.) A. Gray: 1; QU (4474 A); ari; 1100–1200 m.

Mentzelia multiflora (Nutt.) A. Gray var. *multiflora*: 9; CO (6477), QU (6980), SM (7119), UN (7978); ppw, ari-rds, ari, rds, oaw, pmg, row; 1150–2050 m.

? *Mentzelia multiflora* (Nutt.) A. Gray var. aff. *multiflora*: 1; QU (NS-9680); pmg; 1150–1200 m.

Mentzelia nuda (Pursh) Torr. & A. Gray var. *nuda*: 4; QU (4474 B), SM (5979), UN (1776); ari, pmg, rds; 1150–2000 m.

* *Mentzelia* aff. *nuda* (Pursh) Torr. & A. Gray var. *nuda*: 1; CO (5349), lac; 1800–1850 m.

Mentzelia nuda (Pursh) Torr. & A. Gray var. *stricta* (Osterh.) Harrington: 34; CO (7890), HA (7184), QU (6988), SM (5956), UN (7343); rip, pmg, rip-pmg, rds, rsl, fog, pmg-rip, rip-row; 1150–1900 m.

Mentzelia nuda (Pursh) Torr. & A. Gray aff. var. *stricta* (Osterh.) Harrington: 3; QU (2693), UN (2785); rds, pmg; 1300–1450 m.

Mentzelia oligosperma Nutt. ex Sims: 1; HA (6567); rip; 1550–1200 m.

* *Mentzelia* aff. *oligosperma* Nutt. ex Sims: 1; MO (8597); rip; 1550–1600 m.

Mentzelia reverchonii (Urb. & Gilg) H. J. Thomps. & Zavort.: 2; HA (7222), UN (1198); pmg, rds; 1350–1650 m.

Malvaceae

Abutilon parvulum A. Gray: 3; SM (6066), UN (5732); mxs, riw; 1300–1450 m.

Callirhoë involucrata (Torr. & A. Gray) A. Gray var. *involucrata*: 4; UN (6843); ari, oaw, rds; 1550–2000 m.

! *Malva neglecta* Wallr.: 11; CO (4704); HA (5867), MO (8511), SM (8933), UN (7710); rip-ppw, pmg, lac, rip, fog-ari, mcw-rip, rip-pmg; 1450–2450 m.

Sidalcea candida A. Gray var. *candida*: 3; CO (6722); rip-ppw, rip, mog-rip; 1550–2600 m.

Sphaeralcea angustifolia (Cav.) G. Don: 19; MO (DH-12060), HA (4400), SM (4858), UN (2620); pmg-pjw, pmg, rds, mxs, pjw, rip-pmg, riw, rip, pmg-rsl, ppw; 1200–1500 m.

Sphaeralcea coccinea (Nutt.) Rydb. var. *coccinea*: 75; CO (5361), HA (4404), MO (4544), QU (2679), SM (4831), UN (6896); lac, pmg, rds, fog, pmg-lac, pmg-pjw, pmg-rip, mxs, rip, pjw, riw, mcw-rip, oaw, rsl-pmg, ppw; 1150–2200 m.

Sphaeralcea fendleri A. Gray var. *fendleri*: 3; HA (5398), MO (8581), SM (2332); mxs, rip, rds; 1550–2000 m.

Martyniaceae

Proboscidea louisianica (Mill.) Thell subsp. *louisianica*: 2; HA (8331), UN (7647); pmg; 1300–1500 m. Collected from sandy soils.

Melanthiaceae

Veratrum californicum T. Durand: 2; CO (5272); mcw-rip, mog-lac; 2250–2300 m.

Zigadenus elegans Pursh: 2; CO (7536); mog-lac; 2250–2300 m.

Moraceae

! *Maclura pomifera* (Raf.) C. K. Schneid.: 1; HA (DH-12056); 1500–1550 m.

! *Morus alba* L.: 1; HA (NS-9458); rsl-riw; 1550–1600 m.

Myrsinaceae

Lysimachia ciliata L.: 2; CO (7402); ppw, mog-lac; ppw, mog-lac; 2250–2300 m.

Nyctaginaceae

Abronia fragrans Nutt. ex Hook. var. *fragrans*: 23; HA (5027), QU (4500), SM (3869), UN (625); rds; pmg, rip, rip-pmg, ari; 1150–1600 m.

Mirabilis albida (Walter) Heimerl: 2; CO (1830 A), HA (8328); rds, pmg, 1300–2500.

* *Mirabilis* aff. *hirsuta* (Pursh) MacMill.: 2; UN (7332); rip-pmg, pmg; 1400–1550 m.

Mirabilis linearis (Pursh) Heimerl: 38; CO (6788), HA (5053), MO (7825), QU (2666), SM (8944), UN (5678); rds, pmg, rip, pmg, ari, fog-ari, rip-pmg, riw, oaw, fog, rsl, row, rip-row; 1300–2050 m.

Mirabilis multiflora (Torr.) A. Gray var. *multiflora*: 6; CO (6469), HA (8453), SM (4877), UN (2162); ppw, rip, rds, pmg-pjw, rsl; 1350–2050 m.

Mirabilis nyctaginea (Michx.) MacMill.: 2; UN (5688); riv, oaw; 1350–1600 m.

Oleaceae

Forestiera pubescens Nutt. var. *pubescens*: 2; HA (8472), SM (3776); rip, rip-pmg; 1400–1500 m.

! *Syringia vulgaris* L.: 1; HA (NS-9473); rsl-riw; 1550–1600 m.

Onagraceae

Calylophus hartwegii (Benth.) P. H. Raven subsp. *fendleri* (A. Gray) Towner & P. H. Raven: 2; SM (8920), UN (3952); fog-ari, pmg; 1950–2050 m.

? *Calylophus hartwegii* (Benth.) P. H. Raven subsp. aff. *fendleri* (A. Gray) Towner & P. H. Raven: 2; UN (3212), QU (NS-9727); pmg; 1150–1600 m. Collected from rocky substrate.

Calylophus hartwegii (Benth.) P. H. Raven subsp. *pubescens* (A. Gray) Towner & P. H. Raven: 18; HA (4415), QU (4458), SM (5982) UN (4151); 1150–1750 m.

Calylophus lavandulifolius (Torr. & A. Gray) P. H. Raven: 23; CO (5482), HA (733), QU (NS-9813), SM (8205), UN (1521);

rds, pmg-lac, pmg, pmg-rsl, rip-pmg, pmg-pjw, rip-oaw, rip-row; 1150–1950 m.

Calylophus serrulatus (Nutt.) P. H. Raven: 38; HA (4898), QU (2686), UN (6848); pal, pmg, rds, riw, pmg-rip, ari, fog; 1250–1840 m.

Epilobium ciliatum Raf. var. *glandulosum* (Lehm.) Dorn: 4; CO (7560), MO (8800); mog-lac, rip; 2250–2500 m.

Gaura coccinea (Nutt.) Pursh: 105; CO (5123), HA (5087), MO (4549), QU (4499), SM (5931), UN (5749); pmg, rds, fog, ppw, pal, mxs, rip-pmg, rip, pmg-pjw, pjw, rds, ari, oaw, lac, pjw, riw, mcw-rip, row, rip-row, rsl-pmg; 1100–2250 m.

Gaura parviflora Douglas ex Lehm.: 33; CO (6762), HA (7253), MO (2261), QU (7008), SM (5985), UN (1668); rds, lac, ari, rip-pmg, rip, pmg, ppw, mxs, fog-ari, oaw; 1150–2200 m. [=*Gaura mollis* James]

Gaura villosa Torr. var. *villosa*: 13; HA (4940), QU (7007), UN (317); pmg, rds, pmg-rip; 1150–1550 m.

Ludwigia peploides (Kunth) P. H. Raven: 1; UN (7370); ari; 1550–1600 m.

Oenothera albicaulis Pursh: 46; CO (5496), HA (5843), MO (3147), QU (4468), SM (6064), UN (5771); rds, rip-ppw, pmg, rip-pmg, rip, pmg-pjw, mxs, pmg-lac, mxs-lac, ari, pjw, riw; 1100–2250 m.

* *Oenothera* aff. *albicaulis* Pursh: 2; MO (6342), SM (2299); rds; 1950–2300 m.

Oenothera canescens Torr. & Frém.: 3; CO (DH-11766), UN (6813); ari, pmg; 1400–1900 m.

Oenothera cespitosa Nutt. var. *cespitosa*: 1; SM (NS-9642); ppw; 1200–1250 m.

Oenothera cespitosa Nutt. var. *macroglottis* (Rydb.) Cronquist: 1; CO (5289); oaw-rip; 2350–2400 m.

Oenothera coronopifolia Torr. & A. Gray: 17; CO (7459), HA (6582), MO (8815), SM (8870), UN (881); ppw, mog-rip, fog, pmg, rip, rds, mxs, rip-pmg; 1250–2600 m.

Oenothera elata Kunth var. *hirsutissima* (A. Gray ex S. Watson) Cronquist: 7; CO (7543), HA (8423), MO (8491), UN (2438); mog-lac, rip, ppw, ari; 1450–2300 m.

? *Oenothera. elata* Kunth var. aff. *hirsutissima* (A. Gray ex S. Watson) Cronquist: 1; MO (6382); rip-ppw; 2300–2350 m.

Oenothera engelmannii (Small) Munz: 2; HA (4938), UN (880); pmg, pmg-rip; 1300–1400 m.

Oenothera flava (A. Nelson) Garrett: 5; HA (5431), MO (3146), SM (3348), UN (5184); mxs, mxs-lac, rip, pmg, mcw-rip; 1550–2000 m.

Oenothera pallida Lindl. var. *runcinata* (Engelm.) Cronquist: 1; MO (DH-11735); 1600–1650 m.

Oenothera villosa Thunb. var. *strigosa* (Rydb.) Dorn: 3; CO (6641), UN (8034); rip, mog-rip, oaw; 1550–2600 m.

? *Oenothera. villosa* Thunb. var. aff *strigosa* (Rydb.) Dorn: 1; MO (7845); pmg; 1550–1600 m.

# *Oenothera villosa* (Kunth) P. H. Raven var. *villosa*: 1; MO (8825); rip; 2450–2500 m.

Orchidaceae

Corallorhiza sp.: 1; MO (4766); lac; 2400–2450 m.

Corallorhiza striata Lindl.: 2; CO (2661); rip-ppw, mog-lac; 1800–2300 m.

Platanthera purpurascens (Rydb.) Sheviak & W. F. Jenn.: 1; CO (9042); mog-rip; 2550–2600 m.

Orobanchaceae

Castilleja integra A. Gray var. *integra*: 32; CO (4689), HA (4432), MO (4566), SM (7107), UN (3946); rip-ppw, mog-rip, fog, pmg-pjw, mxs, rip, pjw-row, mxs-lac, rds, rip-row, ppw, lac, oaw, ari, pjw, rip-pmg, rip-oaw, pmg; 1350–2600 m.

Castilleja miniata Douglas ex Hook. var. *miniata*: 1; CO (6690); rip; 2400–2450 m.

Castilleja sessiliflora Pursh: 5; HA (4590), QU (9806), SM (4525); pmg-lac, pjw, lac, pmg, rip; 1100–1900 m.

Orobanche ludoviciana Nutt. var. *multiflora* (Nutt.) Beck: 7; HA (8240), SM (6059), UN (993); pmg, mxs, rip-pmg; 1300–1650 m.

Orthocarpus luteus Nutt.: 2; CO (9073), UN (8002); mog-rip, oaw; 1550–2600 m.

Pedicularis procera A. Gray: 5; CO (5273), MO (8803); mcw-rip, mog-lac, mog-rip, rip; 2250–2600 m.

Oxalidaceae

Oxalis corniculata L.: 4; SM (6143), UN (3243); rip, rip-pmg, ari; 1400–2000 m.

Oxalis violacea L.: 1; CO (6629); rip; 2400–2450 m.

Papaveraceae

Argemone hispida A. Gray: 11; CO (5114), MO (7838), UN (692); rds, fog, ppw, pmg, oaw, row; 1450–2200 m.

Argemone polyanthemos (Fedde) G. B. Ownbey: 7; UN (5569); pmg-rip, pmg; 1350–1600 m.

Argemone squarrosa Greene var. *squarrosa*: 6; UN (6953); pmg, pmg-rip; 1400–1650 m. A number of collections were made from lava substrates.

Corydalis aurea Willd. var. *aurea*: 6; CO (5294), MO (3362); UN (NS-9410); oaw-rip, mcw-rip, mcw, rip, oaw, pmg; 1400–2500 m.

? *Corydalis aurea* Willd. var. aff. *aurea*: 1; MO (8510); rip; 1550–1600 m.

Corydalis aurea Willd. var. *occidentalis* Engelm. ex A. Gray: 10; CO (4675), MO (3141), QU (NS-9740), SM (3832), UN (4156); 1150–1850 m.

! *Eschscholzia californica* Cham. subsp. *californica*: 1; SM (NS-9626); pmg; 1250–1300 m.

Phrymaceae

Mimulus glabratus Kunth var. *jamesii* (Torr. & A. Gray ex Benth.) A. Gray: 1; UN (5193); mcw-rip; 2100–2200 m.

Plantaginaceae

* *Collinsia* aff. *parviflora* Lindl.: 1; CO (9031 B); lac; 1800–1850 m.

Besseya plantaginea (E. James) Rydb.: 2; MO (4736); mog-rip, rip-ppw; 2300–2400 m. [=*Synthris plantagenia* (E. James) Benth.]

!! *Linaria dalmatica* (L.) Mill. subsp. *dalmatica*: 1; CO (9057); mog-rip; 2550–2600 m.

Nuttallanthus texanus (Scheele) D.A. Sutton: 4; SM (6286), UN (3228); rip-pmg, pjw, ari; 1550–2250 m. [=*Linaria canadensis* (L.) Dum. Cours. var. *texana* (Scheele) Pennell]

Penstemon albidus Nutt.: 1; UN (3493); pmg; 1500–1550 m.

Penstemon ambiguus Torr.: 16; HA (5061), SM (4842), UN (5554); pmg, rds, pmg-rip; 1300–1600 m.

Penstemon angustifolius Nutt. ex Pursh var. *caudatus* (A. Heller) Rydb.: 1; CO (5115); rds; 1850–1900 m.

~ *Penstemon auriberbis* Pennell: 10; HA (4427), UN (4164); pmg-pjw, pmg, pmg-rip, riw, rds; 1300–1650 m.

Penstemon barbatus (Cav.) Roth var. *torreyi* (Benth.) A. Gray: 13; CO (6647), HA (6561), MO (7803), SM (8898), UN (7964); rip, rip-ppw, mog-lac, rds, pjw-row, ppw-pjw, pmg, mxs, rip-pmg, oaw; 1550–2450 m.

Penstemon buckleyi Pennell: 3; UN (3193); pmg, rds; 1500–2000 m.

Penstemon fendleri A. Gray: 2; HA (4598), SM (4527); pmg-lac, lac; 1800–1850 m.

Penstemon glaber Pursh var. *brandegeei* (Porter) Freeman: 3; CO (7501), UN (8022); mog-lac, rds, oaw; 1550–2500 m.

Penstemon gracilis Nutt.: 1; CO (7531); mog-lac; 2250–2300 m.

Penstemon inflatus Crosswhite: 1; CO (6633); rip; 2400–2450 m.

Penstemon jamesii Benth: 28; CO (5484), HA (5900), MO (4564), QU (4463), SM (6159), UN (6954); rds, fog, ppw, pmg, ari, mxs, rip, rip-pmg, pjw-pmg; 1150–2200 m.

Penstemon rydbergii A. Nelson var. *rydbergii*: 2; CO (6511), UN (4210); ppw, rip-oaw; 1900–2400 m.

Penstemon secundiflorus Benth.: 19; HA (765), QU (NS-9760), SM (4873), UN (9424); pmg, rip, rds, mxs, pjw, rip-pmg, pjw-mxs, pjw-pmg, rsl-pmg; 1150–1850 m.

Penstemon strictiformis Rydb.: 2; HA (5104), UN (5529); rds; 1350–2000 m.

Penstemon strictus Benth.: 2; CO (7444); ppw, mog-rip; 2300–2600 m.

Penstemon virgatus Gray var. *virgatus*: 1; CO (9094); mog-rip; 2550–2600 m.

Plantago eriopoda Torr.: 2; SM (6110), UN (5619); rip, pmg-rip; 1400–2000 m.

! *Plantago lanceolata* L.: 9; CO (4682), HA (5450), MO (8576), SM (7117); rip-ppw, rip, rds, ari; 1550–2350 m.

! *Plantago major* L. var. *major*: 2; MO (8526); rip, pmg; 1550–1600 m.

Plantago patagonica Jacq.: 47; CO (5121), HA (5845), MO (4541), QU (6992) SM (6063), UN (5556); fog, pmg-lac, pmg, rds, rip, rip-pmg, pjw, ari, mxs, ari, pjw, riw, oaw, rip-oaw, pjw-pmg, rsl-pmg, ppw; 1100–2300 m.

Veronica americana Schwein. ex Benth.: 1; CO (7558); mog-lac; 2250–2300 m.

Veronica catenata Pennell: 12; HA (4974), MO (8796), SM (3846), UN (5665); rip, rip-pmg, riw, mcw-rip, oaw, ari; 1300–2500 m.

Veronica peregrina L. var. *xalapensis* (Kunth) H. St. John & F. W. Warren: 6; HA (3325), UN (5815); 1300–1800 m.

! *Veronica serpyllifolia* L. var. *humifusa* (Dickson) Vahl: 1; CO (3408); pmg-lac; 1800–1850 m.

Poaceae

Achnatherum hymenoides (Roem. & Schult.) Barkworth: 40; CO (6779), HA (5389), MO (7856), SM (4534), UN (2882); rds, fog, ppw, mxs, rip, pmg, mxs, lac, ari, pmg-rip, oaw, pjw-mxs; 1250–2050 m. [=*Oryzopsis hymenoides* (Roem. & Schult.] Ricker ex Piper]

Achnatherum robustum (Vasey) Barkworth: 10; CO (8744), SM (7130), UN (1804); rds, mog-rip, ari, fog-ari, oaw, pmg; 1550–2600 m.

!! *Aegilops cylindrica* Host: 6; CO (5500), MO (6225), SM (4539), UN (5534); rds, ppw, lac, pmg-rip, oaw; 1400–2200 m.

Agropyron triticeum Gaertn.: 1; SM (NS-9846); rip; 1800–1850 m. [=*Eremopyron triteceum* (Gaertn.) Nevski]

Agrostis exarata Trin.: 5; CO (7954), HA (8484), SM (8883), UN (7314); rip, mog-rip, rip, mxs, rip-pmg; 1450–2600 m.

Agrostis scabra Willd.: 2; CO (7946); rip, mog-lac; 1250–1600 m.

! *Agrostis stolonifera* L.: 11; CO (7950), HA (7255), MO (8865), SM (8886); rip, mog-lac, rds, ppw, mog-rip, rip-pmg, pmg, mxs; 1350–2500 m.

Alopecurus aequalis Sobol. var. *aequalis*: 2; CO (7603), MO (8861); mog-lac, rip; 2250–2500 m.

Andropogon gerardii Vitman: 7; HA (7789), MO (8551), QU (2719), UN (7320); pjw, rip, rds, oaw, rip-pmg, pmg, rip-row; 1300–1800 m.

Andropogon hallii Hack.: 12; HA (465), MO (8867), UN (7669); pmg, ppw-pjw, rip, rip-pmg, row, rds; 1300–2500 m.

Aristida adscensionis L.: 8; UN (2036); pmg-rsl, rip-pmg, rds, pmg, rip-row; 1300–1750 m.

Aristida divaricata Humb. & Bonpl. ex Willd.: 1; HA (8374); rip; 1300–1350 m.

Aristida havardii Vasey: 11; UN (2043); pmg-rsl, pmg, rds, rip; 1350–1750 m.

Aristida purpurea Nutt. var. *longiseta* (Steud.) Vasey: 86; CO (5510), HA (5853), MO (7855), QU (7013), SM (8216), UN (6919); rds, pmg, rip-pmg, rip, pal, pjw, pjw-row, mxs, fog-ari, riw, pmg-pjw, row, rsl, pmg-rsl, ppw; 1150–2200 m.

Aristida purpurea Nutt. var. *purpurea*: 29; CO (6777), HA (5380), QU (2728), SM (6007), UN (6839); rds, mxs, pmg, pmg-pjw, ari, pjw, oaw, pmg-rip, rip-row; 1300–1850 m.

Aristida purpurea Nutt. var. *wrightii* (Nash) Allred: 6; HA (6574), SM (6109); rip, pmg, mxs; 1300–1800 m.

! *Avena fatua* L.: 1; UN (1672), rds; 1650–1700 m.

Blepharoneuron tricholepis (Torr.) Nash: 2; CO (9132); mog-rip, rds; 2300–2600 m.

Bothriochloa barbinodis (Lag.) Herter: 2; SM (7028), UN (2555); 1200–1400 m.

! *Bothriochloa ischaemum* (L.) Keng var. *songarica* (Rubr. ex Fisch. & C. A. Mey.) Celarier & Harlan: 16; HA (8652), QU (2726), UN (2039); pmg, rds, pmg-rip, pmg-rsl, rsl, rip-row, rip; 1150–1850 m.

Bothriochloa laguroides (DC) Herter subsp. *torreyana* (Steudel) Allred & Gould: 49; HA (6617), MO (8540), QU (7011), SM (8144), UN (7667); rip, pmg, pjw, rip-pmg; rip, rds, mxs, ari, pmg-rsl, pmg-pjw, row; 1150–2000 m. Specimens were identified initally as *B. saccharoides*.

Bothriochloa springfieldii (Gould) Parodi: 6; HA (3109), SM (8159), UN (1933); mxs, rip-pmg, rds, rsl, rip-row; 1350–1550 m.

Bouteloua curtipendula (Michx.) Torr. var. *caespitosa* Gould & Kapadia: 5; QU (2718), SM (8885), UN (2037); rds, mxs, pmg-rsl, pmg; 1300–2000 m.

Bouteloua curtipendula (Michx.) Torr. var. *curtipendula*: 62;

HA (7781), MO (8544), SM (8967), UN (7318); pjw, pmg, ppw-pjw, pjw-row, mxs, rip, rds, fog-ari, ari, pmg-rip, oaw, pmg-pjw, row, fog, rsl, rip-row; 1150–2050 m.

Bouteloua dactyloides (Nutt.) J.T. Columbus: 68; CO (4268), HA (5833), MO (2266), SM (8134), UN (6891); lac, pmg, rds, rip, mxs, rip-pmg, pjw, riw, pmg-pjw, rsl, fog, pmg-rsl, rip-row; 1150–2250 m.

Bouteloua eriopoda (Torr.) Torr.: 4; HA (3102), MO (DH-12185), SM (8118 A); mxs, pmg-rip; 1400–1650 m.

Bouteloua gracilis (Kunth) Lag.: 78; CO (9018), HA (7782), MO (8863), QU (2715), SM (8970), UN (7310); lac, mog-rip, rds, pjw, pmg, rip, rip-pmg, pjw-row, mxs, fog-ari, oaw, row, fog, pmg-pjw, pmg-rsl; 1300–2500 m.

Bouteloua hirsuta Lag. var. *hirsuta*: 25; HA (8478), MO (DH-12057), SM (8160), UN (2123); rip, pmg, rip-pmg, pjw, mxs, rds, pmg-pjw, rsl, rip-row; 1150–1900 m.

Bromus anomalus Rupr. ex E. Fourn.: 3; CO (8748), HA (562); rds, mog-rip, ppw-pjw; 1700–2600 m.

! *Bromus catharticus* Vahl: 22; CO (4629), HA (5887), MO (8856), QU (NS-9801), SM (2341); rds, pmg, mog-rip, mxs, pjw, mxs-lac, rip, oaw, pjw; 1100–2600 m.

Bromus ciliatus L.: 4; CO (7610), HA (NS-9492); mog-lac, rip, rds; 1550–2350 m.

! *Bromus inermis* Leyss. var. *inermis*: 33; CO (5131), HA (4620), MO (8866), SM (4538), UN (1742); rds, rip, rip-ppw, ppw, ari, fog, pmg-lac, pjw-row, lac, fog-ari, pmg; 1550–2500 m.

! *Bromus japonicus* Thunb. ex Murray: 41; CO (5362), HA (4993), MO (490), QU (NS-9830) SM (2342), UN (5224); lac, rds, ari, ppw, mog-lac, rip, rip-pmg, riw, oaw, rsl-pmg, rip-row; 1350–2350 m.

Bromus lanatipes (Shear) Rydb.: 9; CO (6689), HA (4388), MO (4574), SM (8888), UN (6929); rip, rds, rip-pmg, mxs, riw, pmg; 1350–2500 m.

! *Bromus tectorum* L.: 42; CO (5316), HA (5415), MO (6422), QU (NS-9709), SM (5961), UN (263); rip-ppw, oaw-rip, pmg, ppw, mxs, rds, mog-rip, oaw, rip-pmg, pjw, mcw-rip, riw, ari, pjw-ppw; 1150–2400 m.

Calamagrostis stricta (Timm) Koeler subsp. *inexpansa* (A. Gray) C.W. Greene: 1; CO (9134); mog-rip; 2550–2600 m.

Cenchrus longispinus (Hack.) Fernald: 14; HA (8285), MO (8550), SM (5975), UN (2018); pmg, mxs, rip, ari, pmg-rip, pmg-rsl, rds, rip-row; 1250–1600 m.

Cenchrus spinifex Cav.: 1; QU (2714); rds; 1300–1350 m.

Chloris verticillata Nutt.: 22; HA (5044), QU (2712), SM (8976), UN (1200); pmg, rds, mxs, fog-ari, pmg-rip, rsl, pmg-rsl, rds, rip, rip-row, rsl-riw; 1250–2050 m.

! *Cynodon dactylon* (L.) Pers. var. *dactylon*: 2; SM (6097); mxs; 1250–1350 m.

! *Dactylis glomerata* L.: 20; CO (5322), MO (4755), SM (7129), UN (3965); oaw-rip, rip, rip-ppw, rds, ppw, mog-rip, lac, ari, rip-pmg, pmg, pjw, pjw-oaw; 1200–2450 m.

Danthonia parryi Scribn.: 2; CO (7606); mog-lac, ppw; 2250–2350 m.

Danthonia spicata (L.) P. Beauv. ex Roem. & Schult.: CO (7461); ppw; 2250–2300 m.

Dichanthelium oligosanthes (Schult.) Gould var. *scribnerianum* (Nash) Gould: 3; HA (5446), SM (6154); rip, rip-pmg; 1700–2250 m.

Digitaria californica (Benth.) Henrard: 1; HA (9475); rsl-riw; 1550–1600 m.

Distichlis spicata (L.) Greene var. *stricta* (Torr.) Scribn.: 4; HA (4391), MO (7854); rip-pmg, pal, pmg; 1350–1600 m.

# ! *Echinochloa crus-pavonis* (Kunth) J.A. Schultes var. *crus-pavonis*: 1; UN (257); pmg; 1450–1500 m. The specimen should be re-examined given the infrequency of the variety in the North America.

! *Echinochloa crus-pavonis* (Kunth) Schult. var. *macra* (Wiegand) Gould: 8; QU (4503), SM (5965), UN (2665); ari, rds, rip-pmg, pmg, pmg-rsl, rip-row; 1150–1550 m.

Echinochloa muricata (P. Beauv.) Fernald var. *microstachya* Wiegand: 10; HA (8379), SM (8167), UN (7665); rip, rip-pmg, pjw, pmg, fog-ari, mxs, oaw; 1300–2050 m.

Echinochloa muricata (Beauv.) Fern. var. *muricata*: 1; UN (7405); ari; 1550–1600 m.

Elymus canadensis L.: 49; CO (7948), HA (6623), MO (7851), SM (7131), UN (327); rip, mog-lac, ari, rds, ppw, mxs, rip, pmg, ppw-pjw, pmg, pmg-rip, riw, oaw, rds, oaw, pmg-rsl, rip-row; 1300–2500 m.

! *Elymus elongatus* (Host) Runem. var. *elongatus*: 1; SM (8974); fog-ari; 2000–2050 m. [=*Leymus racemosus* (Lam.) Tzev.]

Elymus elymoides (Raf.) Swezey var. *brevifolius* (J. G. Sm.) Dorn: 127; CO (5132); HA (4622), MO (8854), QU (4502), SM (4872), UN (5219); rds, lac, ari, mog-lac, mog-rip, rip, fog, pmg-lac, ppw, pmg-pjw, pmg, pmg-rip, pjw, mxs, mxs-lac, oaw, fog-ari, riw, mcw-rip, row, rip-row; rsl-pmg; pjw-ppw; 1150–2600 m.

! *Elymus giganteus* Vahl.: 1; CO (6758); rip; 2150–2200 m. [=*Leymus racemosus* (Lam.) Tzvelev]

Elymus glaucus Buckley var. *glaucus*: 1; UN (8082); oaw; 1550–1600 m.

Elymus lanceolatus (Scribn. & J. G. Sm.) Gould var. *lanceolatus*: 1; UN (8086); oaw; 1550–1600 m.

Elymus smithii (Rydb.) Gould: 74; CO (6774), HA (6618), MO (8858), SM (8981), UN (5526); rds, ari, mog-lac, mog-rip, ppw, fog, pmg-lac, mxs, rip, pjw, pmg, rip-pmg, pal, fog-ari, riw; 1300–2600 m.

Elymus trachycaulus (Link) Gould ex Shinners var. *trachycaulus*: 18; CO (8740), SM (7027), UN (389); rds, mog-lac, lac, rip, ari, pmg-rip, oaw, rip-pmg, pmg; 1400–2500 m.

! *Eragrostis cilianensis* (All.) Vignolo ex Janch.: 6; SM (8133), UN (2067); pmg-rip, pmg-rsl, rds, rip-row; 1300–1500 m.

Eragrostis curtipedicellata Buckley: 3; CO (5506), SM (6057), UN (7662); rds, mxs, rip-pmg; 1250–1950 m.

! *Eragrostis curvula* (Schrad.) Nees var. *conferta* Stapf.: 1; UN (5595); pmg-rip; 1400–1450 m.

Eragrostis pilosa (L.) P. Beauv. var. *pilosa*: 2; MO (8554), SM (8975); rip, fog-ari; 1550–2050 m. Previously reported in NM but no specimens otherwise known.

Eragrostis secundiflora J. Presl subsp. *oxylepis* (Torr.) S. D. Koch: 9; HA (8336), UN (872); pmg, mxs; 1300–1600 m.

Eragrostis sessilispica Buckley: 4; HA (5098), UN (948); pmg; 1300–1600 m. Specimens collected from sandy soil.

Eragrostis trichodes (Nutt.) A. W. Wood: 5; HA (1352); pjw-row, ppw-pjw, mxs, rip; 1500–1800 m.

Erioneuron pilosum (Buckley) Nash: 39; CO (4630), HA (4337), QU (4504), SM (6105), UN (5706); pmg, fog, mxs, pmg-pjw, rip, ari, rds, pmg-rip, riw, row, pmg-rsl, rsl-riw, pjw, ppw; 1150–2000 m.

* *Festuca* aff. *arizonica* Vasey: 1; CO (6547); ppw; 2300–2350 m.

Festuca idahoensis Elmer var. *idahoensis*: 1; CO (9133); mog-rip; 2550–2600 m.

Festuca thurberi Vasey: 1; MO (6365); rds; 2250–2300 m.

Glyceria elata (Nash ex Rydb.) M. E. Jones: 2; CO (9143), UN (8090); mog-rip, oaw; 1550–2600 m.

Glyceria grandis S. Watson: 1; MO (8862); rip; 2450–2500 m.

Glyceria striata (Lam.) Hitchcock var. *stricta* (Scribn.) Fernald: 2; UN (5160); mcw-rip, oaw; 1550–1600 m.

Hesperostipa comata (Trin. & Rupr.) Barkworth var. *comata*: 22; CO (7953), HA (4907), QU (3677), UN (1983); rip, pmg, pal, mxs, ari, rds, pmg-rip, riw; 1250–1750 m. [=*Stipa comata* Trin. & Rupr.]

Hesperostipa comata (Trin. & Rupr.) Barkworth var. *intermedia* (Scribn. & Tweedy) Barkworth: 1; UN (4188), pmg, 1450–1500 m.

Hesperostipa neomexicana (Thurb.) Barkworth: 17; CO (5508), HA (4621), MO (6252), QU (NS-9731), SM (3939), UN (4015); rds, pmg, pmg-lac, pmg-pjw, ppw, mxs, pjw, rip-pmg, pjw-mxs, rsl-pmg; 1150–2200 m. [=*Stipa neomexicana* (Thurb. ex Coult.) Scribn.]

Hesperostipa spartea (Trin.) Barkworth: 1; CO (7589); mog-lac; 2250–2300 m. [=*Stipa spartea* Trin.]

Hilaria jamesii (Torr.) Benth.: 50; CO (5344), HA (5048), MO (4575), QU (NS-9713), SM (3938), UN (1229); lac, rds, fog, pmg, rip-pmg, pmg-pjw, rip, mxs, pjw, riw, row, pmg-rsl, rslpjw-mxs; 1150–1850 m.

Hilaria mutica (Buckl.) Benth.: 6; SM (6054), UN (348); mxs, rds, pmg-rip, pmg; 1250–1500 m.

Hordeum jubatum L.: 22; CO (5343), HA (5442), MO (7857), SM (7074), UN (5694); pal, pmg-rip, lac, pmg, rip, mog-lac, ppw, mxs, rip, ari, rip-pmg, riw; 1300–2050 m.

Hordeum pusillum Nutt.: 53; CO (5499), HA (6608), MO (4576), QU (3652), SM (5966), UN (5527); rds, rip, mxs, pmg, pmg-pjw, mxs-lac, oaw, rip-pmg, pjw, riw, rsl-pmg, ppw; 1150–2250 m.

! *Hordeum vulgare* L.: 6; CO (5501), SM (6306), UN (4204); rds, rip-ppw, lac, rip-pmg, pjw; 1450–2250 m.

Koeleria macrantha (Ledeb.) Schult.: 12; CO (7958), SM (8879), UN (8089); rip, ppw, mog-lac, rds, mog-rip, mxs, rip-pmg, oaw; 1550–2600 m.

Leptochloa fusca (L.) Kunth subsp. *fascicularis* (Lam.) N. Snow: 3; SM (8166), UN (7401); mxs, ari, rip-pmg; 1450–1600 m.

Lycurus phleoides Kunth: 8; HA (7790), SM (8884), UN (1036); pjw, ppw-pjw, mxs, pmg, rip-row; 1350–1900 m.

Lycurus setosus (Nutt.) C. Reeder: 10; HA (8650), MO (8552), UN (2825); pmg, ppw-pjw, rip, rip-pmg, rsl, pmg-pjw, rds; 1350–1850 m.

Melica porteri Scribn.: 1; CO (7600); mog-lac; 2250–2300 m.

Munroa squarrosa (Nutt.) Torr.: 1; CO (DH-11765); 1850–1900 m.

Muhlenbergia arenacea (Buckley) Hitchc.: 1; QU (2717 B); rds; 1300–1350 m.

Muhlenbergia arenicola Buckley: 12; HA (7206), QU (2717 A), UN (2881); pmg, rip, rds, rsl, row, pmg-rsl; 1300–1750 m.

Muhlenbergia asperifolia (Nees & Meyen ex Trin.) Parodi: 3; CO (9020), UN (2125); lac, rip-pmg, rip; 1300–1850 m.

* *Muhlenbergia* aff. *asperifolia* (Nees & Meyen ex Trin.) Parodi: 1; CO (9021); lac; 1800–1850 m.

Muhlenbergia montana (Nutt.) Hitchc.: 3; CO (9135), HA (1351); mog-rip, rds, pjw-row; 1750–2600 m.

Muhlenbergia pungens Thurb.: 1; UN (1998 A); rds; 1700–1750 m.

Muhlenbergia repens (J. Presl) Hitchc.: 1; SM (NS-9896); pjw; 1650–1700 m.

Muhlenbergia torreyi (Kunth) Hitchc. ex Bush: 11; HA (750), UN (2821); pmg, pmg-pjw, rip, pmg, rds, fog; 1300–1900 m.

Muhlenbergia wrightii Vasey ex J. M. Coult.: 2; CO (1850), UN (1502); rds, rip-pmg; 1700–2350 m.

Nassella viridula (Trin.) Barkworth: 3; MO (2278), UN (1739); rds, ppw; 1900–2250 m. [=*Stipa viridula* Trin.]

Panicum bulbosum Kunth: 1; SM (8142); pmg-rip; 1400–1450 m.

Panicum capillare L.: 7; CO (9017), HA (DH-12134), MO (2271), SM (8977), UN (2765); lac, rip, rds, fog-ari, pmg; 1450–2050 m.

Panicum hallii Vasey var. *hallii*: 10; HA (6619), UN (2017); rip, rip-pmg, pmg-rsl, rds, row, pmg, rip-row; 1300–1650 m.

Panicum obtusum Kunth: 36; HA (7279), MO (8541), QU (2716), SM (6108), UN (8704); rip-pmg, pjw, rip, pmg, mxs, rip, rds, ari, fog-ari, riw, rsl, row, pmg-rsl, pmg-pjw; 1250–2050 m.

Panicum virgatum L.: 12; CO (7478), HA (8481), MO (7852), UN (6921); ppw, rip, rip-pmg, pmg, rip; 1350–2300 m.

Paspalum setaceum Michx.: 5; HA (8378), UN (1031); rip, pmg, rip-row; 1300–1550 m.

! *Phleum pratense* L.: 9; CO (7588), MO (8855), UN (709); mog-lac, rip, ppw, rds, mog-rip, rds; 1550–2600 m.

Piptatherum micranthum (Trin. & Rupr.) Barkworth: 7; CO (6747), UN (5153); rip-ppw, rip, mog-lac, ppw, mcw-rip, ari; 1550–2350 m. [=*Oryzopsis micrantha* (Trin. & Rupr.) Thurb.

Poa arida Vasey: 2; CO (8722), SM (6166); rds, rip; 1950–2500 m.

Poa bigelovii Vasey & Scribn.: 5; HA (5395), MO (3157 B), SM (3744); mxs, mxs-lac, rip, pjw, rip-pmg; 1550–1950 m.

Poa fendleriana (Steud.) Vasey: 14; CO (5323), MO (4754), SM (3748), UN (3620); oaw-rip, ari, mcw, mog-rip, lac, rip, pjw, mcw-rip, rds, pmg-rip, pjw-oaw, pjw-ppw; 1500–2500 m.

* *Poa* aff. *fendleriana* (Steud.) Vasey: 1; CO (6692); rip; 2400–2450 m.

Poa interior Rydb.: 2; CO (7417), UN (4257); ppw, rip-oaw; 1900–2300 m.

Poa palustris L.: 11; CO (5325), HA (5443), MO (4780), SM (3880), UN (8091); oaw-rip, mcw-rip, mog-lac, rip, rip-pmg, lac, oaw; 1400–2450 m.

! *Poa pratensis* L.: 58; CO (6752), HA (4992), MO (4753), SM (4536), UN (4258); rip-ppw, rip, pmg, rds, oaw-rip, lac, ari, ppw, fog, pmg-lac, pal, mxs, rip-pmg, ppw-pjw, mxs-lac, pjw, mcw-rip, oaw; 1300–2450 m.

* ! *Poa* aff. *pratensis* L.: 1; UN (5161); mcw-rip; 2100–2200 m.

! *Poa trivialis* L.: 1; SM (6182); rip; 1950–2000 m.

Poa wheeleri Vasey: 2; CO (9034), UN (5156); lac, mcw-rip; 1800–1850 m. [=*Poa nervosa* (Hook.) var. *wheeleri* (Vasey) C. L. Hitchc.]

! *Polypogon monspeliensis* (L.) Desf.: 16; CO (9032), HA (5385), MO (7858), QU (7009), UN (6802); lac, mxs, rip, pmg-rip, pmg, rds, riw, ari; 1150–1850 m.

Schedonnardus paniculatus (Nutt.) Trel.: 19; CO (7415), HA (7787), SM (6101), UN (1992); ppw, rip-pmg, pjw, pmg, mxs, fog-ari, oaw, pmg-rsl, rds; 1300–2300 m.

! *Schedonorus arundinacea* (Schreb.) Dumort.: 10; CO (4631), MO (6224), SM (4806), UN (3985); oaw, pmg, rds, rip-ppw, ppw, pjw, rip-pmg, rip-oaw, pjw-oaw; 1650–2350 m. [=*Festuca arundinacea* Schreb.]

Schizachyrium scoparium (Michx.) Nash var. *scoparium*: 18; CO (7479), HA (6620), MO (8558), SM (8880), UN (1997); ppw, mog-rip, rip, pmg, mxs, rip-pmg, pmg-pjw, rds, rip-row; 1300–2300 m.

Setaria leucopila (Scribn. & Merr.) K. Schum.: 13; HA (6599), QU (7010), SM (8138), UN (2558); rip, mxs, rds, mxs, pmg-rip, pmg, rip-row, rsl-riw; 1150–1600 m.

! *Setaria viridis* (L.) P. Beauv.: 12; CO (9023), QU (2723), SM (8971), UN (2878); lac, ari, ppw, rds, fog-ari, oaw, rip-pmg, pmg; 1300–2050 m.

Sorghastrum nutans (L.) Nash: 7; MO (DH-12083), SM (8882), UN (2464); mxs, rip-pmg, pmg, rip; 1300–1900 m.

! *Sorghum halepense* (L.) Pers.: 7; HA (8475), QU (7014), SM (7030); UN (3031); rip, pmg, rds, pmg-rip; 1150–1500 m.

Sphenopholis obtusata (Michx.) Scribn. var. *major* (Torr.) K. S. Erdm.: 3; HA (4987), UN (5676); rip, riw, pmg-rip; 1300–1450 m. Further study may reveal these specimens as *S. intermedia* (Rydb.) Rybd.

Sphenopholis obtusata (Michx.) Scribn. var. *obtusata*: 5; CO (7163), HA (6622), MO (8557), UN (5767); ari, rip, riw; 1400–2000 m.

Sporobolus airoides (Torr.) Torr.: 19; CO (6773), HA (4994), MO (2274), SM (8145); UN (294); rds, ppw, ari, rip, pmg, pal, rip-pmg, pjw; 1300–2300 m.

Sporobolus cryptandrus (Torr.) A. Gray: 40; CO (1849), HA (8377), MO (2273), QU (2729), UN (1080); rds, rip, pmg, mxs, fog, row, pmg-rsl, pmg-rip, pmg-pjw, rip-row; 1300–2350 m.

* *Sporobolus* aff. *cryptandrus* (Torr.) A. Gray: 2; HA (8480), UN (2465 B); rip; 1350–1500 m.

Sporobolus giganteus Nash: 3; HA (DH-12066), UN (918); pmg-rip, pmg; 1350–1600 m.

Tridens albescens (Vasey) Wooton & Standl.: 4; HA (7200 B), SM (3829); pmg, pmg-rip; 1350–1450 m.

Trisetum montanum Vasey var. *montanum*: 1; SM (BR-4124); 2600–2700 m.

! *Triticum aestivum* L.: 3; CO (4632), SM (7029), UN (4187); pmg, rds; 1200–1800 m.

Vulpia octoflora (Walter) Rydb.: 45; HA (4989), MO (4542 A), QU (3649), SM (3743), UN (5539); rip, rip-pmg, pmg, pmg-lac, pmg-pjw, pal, mxs, ari, rds, pjw, bdl; 1100–1950 m.

Polemoniaceae

Collomia linearis Nutt.: 1; CO (7565); mog-lac; 2250–2300 m.

Ipomopsis aggregata (Pursh) V. E. Grant subsp. *candida* (Rydb.) V. E. Grant & A. D. Grant: 4; CO (8767), UN (7963); rds, oaw; 1550–2500 m.

Ipomopsis aggregata (Pursh) V. E. Grant subsp. *formosissima* (Greene) Wherry: 6; CO (7458), MO (8802), UN (7976); ppw, rip, mog-rip, mog-lac, oaw; 1550–2500 m.

Ipomopsis laxiflora (J. M. Coult.) V. E. Grant: 17; HA (4956), QU (NS-9710), SM (6089), UN (5783); pmg, rip, rip-pmg, mxs, rds, ari, pmg-pjw, bdl; 1150–1750 m.

Ipomopsis longiflora (Torr.) V. E. Grant subsp. *longiflora*: 2; SM (8874); mxs, rds; 1850–2000 m.

& *Ipomopsis sancti-spiritus* Wilken & Fletcher: Not collected but known from study area in San Miguel county (Tables 10, 11).

Ipomopsis spicata (Nutt.) V. E. Grant subsp. *spicata*: 1; HA (DH-11749); 1850–1900 m.

Phlox nana Nutt.: 12; SM (6125); lac, rip, ari, rds, rip-pmg, pjw, pjw-oaw, pjw-ppw; 1800–2250 m.

Polemonium foliosissimum A. Gray: 1; CO (7502); mog-lac; 2250–2300 m.

Polygalaceae

Polygala alba Nutt. var. *alba*: 27; HA (4307), QU (4471), SM (6004), UN (6844); pmg, ppw, pmg-pjw, ari, rds, pjw, pmg-rip, pmg-rsl; 1150–1750 m.

Polygonaceae

Eriogonum alatum Torr. var. *alatum*: 14; CO (6705), HA (7743), MO (6208), UN (8048); rip-ppw, ppw, rds, rip, fog, pjw, ari, rip-pmg, oaw, pmg; 1450–2500 m.

Eriogonum annuum Nutt.: 23; HA (8265), SM (8199), UN (7627); pmg, rip-pmg; rds; rip-row; 1300–1850 m.

& *Eriogonum aliquantum* Reveal: Not collected but known from study area in Colfax county (Tables 10, 11).

Eriogonum jamesii Benth. var. *jamesii*: 26; CO (7455), HA (7239); MO (8595), SM (8912), UN (1565); ppw, rip, rds, mog-rip, pmg, mxs, ari, pmg-rip, fog, pmg-pjw, rsl, rip-row; 1350–2600 m.

? *Eriogonum jamesii* Benth. var. aff. *jamesii*: 1; UN (7673); rip-pmg; 1450–1500 m.

Eriogonum lachnogynum Torr. ex Benth.: 9; HA (8616), QU (2691), UN (1561); pmg, rds, pmg-pjw, rsl; 1350–1850 m.

Eriogonum lonchophyllum Torr. & A. Gray var. *fendlerianum* (Benth.) Reveal: 1; UN (7966); oaw; 1550–1600 m.

Eriogonum tenellum Torr. var. *tenellum*: 11; HA (7741), QU (4480), SM (8916), UN (5722); pjw, ari, pmg, mxs, riw, pmg-rip, pmg-pjw, rip-row, pjw-pmg; 1150–1900 m.

? *Eriogonum tenellum* Torr. var. aff. *tenellum*: 1; HA (441); ppw-pjw; 1700–1750 m.

! *Fallopia convolvulus* (L.) Á. Löve: 3; MO (8801), UN (1736); rip, rds; 1950–2500 m.

Persicaria amphibia L. var. *emersua* (Michx.) Hickman: 1; HA (786); pal; 1850–1900 m.

Persicaria amphibia L. var. *stipulacea* (Coleman) Hara: 1; UN (7382); rip-pmg.

Persicaria bicornis (Raf.) Nieuwland: 1; HA (DH-12208); ari; 1700 m.

! *Persicaria lapathifolia* (L.) A. Gray: 7; CO (8996), HA (7728), MO (8844), SM (8100), UN (7396); lac, pjw, rip, pmg-rip, ari, oaw; 1400–2500 m.

! *Persicaria maculosa* A. Gray: 1; MO (8600 B); rip; 1550–1600 m.

Polygonum arenastrum Jord. ex Boreau: 4; HA (4976), UN (7301); rip, pmg, rip-pmg; 1300–1550 m.

! *Polygonum aviculare* L.: 1; SM (8111); pmg-rip; 1400–1450 m.

Polygonum erectum L.: 3; HA (7247), UN (2813); rip-pmg, pmg; 1350–1450 m.

Rumex altissimus A. W. Wood: 13; CO (7878), HA (5434), SM (3786), UN (5671); rip, mxs, rip-pmg, riw, pmg, ari; 1300–1600 m.

! *Rumex crispus* L.:12; CO (6651), HA (4986), MO (8602), SM (7062), UN (8700); rip, rip-ppw, ppw-pjw, pmg, rds, ari, riw, oaw; 1300–2450 m.

Rumex hymenosepalus Torr.: 5; HA (4965), QU (9781), SM (3849), UN (5769); rip, rip-pmg, pmg, bdl; 1150–1350 m.

Rumex maritimus L. var. *fueginus* (Phil.) Dusén: 1; UN (7377); ari; 1550–1600 m.

Rumex salicifolius Weinm. var. *triangulivalvis* (Danser) J. C. Hickman: 5; CO (7154), MO (8603), SM (7105), UN (8046); ari, rip; oaw; 1550–2050 m.

! *Rumex stenophyllus* Ledeb.: 6; CO (9036), HA (8351), SM (8924), UN (6805); lac, rip, fog-ari, ari; 1300–2050 m.

* *Rumex* aff. *verticillatus* L.: 1; UN (7374); ari; 1550–1600 m.

Pontederiaceae

Heteranthera limosa (Sw.) Willd.: 1; HA (DH-12205); lac; 1500–1600 m.

Portulacaceae

! *Portulaca oleracea* L.: 1; UN (2189), pmg; 1400–1500 m.

Portulaca pilosa L.: 1; MO (DH 12181), rip; 1500–1600 m.

Phemeranthus parviflorus (Nutt.) Kiger: 7; HA (448), MO (DH-12209), UN (2070); ppw-pjw, mxs, rip, rip-pmg, pmg; 1300–1750 m. Flora North America (4:493) adopts a broader species concept, which we follow here, but specimens from New Mexico now are often treated as *P. confertiflorus* (Greene) Hershkovitz.

Potamogetonaceae

Potamogeton foliosus Raf. var. *foliosus*: 1; HA (DH-12054); 1500–1600 m.

Potamogeton nodosus Poir: 1; UN (7389), ari; 1550–1600 m.

Primulaceae

Androsace occidentalis Pursh: 3; CO (5244), MO (3358); mcw-rip, mcw, rip; 2250–2500 m.

Androsace septentrionalis L.: 4; CO (5299), SM (6130); rip, oaw-rip, rip-ppw; 1800–2450 m.

Ranunculaceae

Aconitum columbianum Nutt. var. *columbianum*: 1; CO (9052); mog-rip; 2550–2600 m.

Anemone canadensis L.: 1; MO (6396); rip-ppw; 2300–2350 m.

Anemone cylindrica A. Gray: 3; CO (6737); rip-ppw, mog-lac, ppw; 2250–2350 m.

Anemone patens L. var. *multifida* Pritz.: 4; CO (5254), MO (4742); mcw-rip, mog-rip, lac, pmg; 2250–2500 m.

Aquilegia coerulea E. James var. *coerulea*: 1; CO (7487); mog-lac; 2250–2300 m.

Clematis columbiana (Nutt.) Torr. & A. Gray var. *columbiana*: 4; MO (4746), UN (5137); mog-rip, lac, rip, mcw-rip; 2350–2500 m.

Clematis hirsutissima Pursh var. *hirsutissima*: 2; CO (9300); rds, pmg; 2400–2500 m.

Clematis ligusticifolia Nutt.: 3; CO (7580), SM (7108); mog-lac, rip, ari; 1550–2300 m.

Clematis scottii Porter: 3; CO (5306); oaw-rip, mcw-rip, mog-lac; 2250–2400 m.

! *Consolida ajacis* (L.) Schur: 1; CO (7141); ari; 1950–2000 m.

Delphinium nuttallianum Pritz.: 1; CO (9076); mog-rip; 2550–2300 m.

Delphinium ramosum Rydb.: 3; CO (7539), MO (8846); mog-lac, rip; 2250–2500 m.

& *Delphinium robustum* Rydb.: Not collected but known from study area in Colfax county (Tables 10, 11).

& *Delphinium sapellonis* Tidestrom: Not collected but known from study area in Mora county (Tables 10, 11).

Delphinium virescens Nutt.: 18; HA (5412), QU (NS-9774), SM (4881), UN (5656); pmg, mxs, rip, rds, rip-pmg, riw; 1150–2250 m.

* *Delphinium* aff. *virescens* Nutt.: 1; UN (3576); rip-pmg; 1400–1450 m. Specimen collected on rocky substrate.

Myosurus minimus L.: 1; CO (4269); lac; 1800–1850 m. Specimen collected from alkaline soil.

Ranunculus cymbalaria Pursh: 4; HA (8347), MO (4741), UN (5192); rip, mog-rip, mcw-rip; 1300–2400 m.

Ranunculus gmelinii DC.: 1; UN (5190); mcw-rip; 2100–2200 m. Collected from a basalt substrate.

Ranunculus inamoenus Greene var. *inamoenus*: 6; CO (5313); UN (5178); oaw-rip, mcw, mcw-rip, rip-pmg, oaw; 1400–2450 m.

Ranunculus macounii Britton: 4; CO (7438 A); MO (6418); ppw, mog-rip, rip-ppw; 2250–2400 m.

Ranunculus ranunculinus (Nutt.) Rydb.: 1; MO (4732); mog-rip; 2350–2400 m.

Ranunculus sceleratus L. var. *multifidus* Nutt.: 9; SM (6117), UN (5718); ari, rip, rip-pmg, riw; 1300–2000 m.

! *Ranunculus testiculatus* Crantz: 1; CO (4665); rip-ppw; 1800–1850 m.

Thalictrum fendleri Engelm. ex A. Gray: 10; CO (5308), MO (4748); oaw-rip, rip-ppw, rip, mcw-rip, mog-lac, ppw, mog-rip; 2250–2600 m.

* *Thalictrum* aff. *fendleri* Engelm. ex A. Gray: 1; CO (4693); rip-ppw; 1800–1850 m.

Rhamnaceae

Ceanothus fendleri A. Gray: 1; MO (6380); rip-ppw, 2300–2350 m.

Rosaceae

Agrimonia striata Michx.: 5; CO (6744), MO (8824), UN (8013); rip-ppw, mog-lac, rip, oaw; 1550–2500 m.

Amelanchier alnifolia (Nutt.) Nutt. ex M. Roem. var. *alnifolia*: 1; MO (BR-8275); 2800–2900 m.

Cercocarpus montanus Raf. var. *montanus*: 21; CO (6640), HA (6556), MO (494), SM (NS-9591), UN (3996); rip, rip-ppw, rds, ppw, pjw-row, mog-rip, rip-row, oaw, rsl, mxs, pjw-mxs; 1350–2450 m.

Crataegus erythropoda Ashe: 1; CO (NS-9283); oaw; 1950–2150 m.

Fallugia paradoxa (D. Don) Endl. ex Torr.: 11; CO (6701), HA (5393), MO (7806), SM (5945), UN (1157); rip-ppw, rip, mxs, pmg, rip-row, rds, fog; 1400–2350 m.

Fragaria vesca L.: 1; CO (6660); rip; 2400–2450 m.

Fragaria virginiana Mill.: 3; CO (5259), UN (4219); mcw-rip, rip-oaw, oaw; 1900–2300 m.

Geum aleppicum Jacq.: 2; CO (7886); ppw, rip; 1550–2300 m.

Geum macrophyllum Willd. var. *perincisum* (Rydb.) Raup: 1; CO (6745); rip-ppw; 2300–2350 m.

Holodiscus dumosus (Nutt. ex Hook.) A. Heller var. *dumosus*: 2; CO (6642); rip, mog-lac; 2250–2450 m.

Physocarpus monogynus (Torr.) J. M. Coult.: 3; CO (6680), MO (6379), UN (5139); 2100–2450 m.

Potentilla anserina L.: 1; MO (4740); mog-rip; 2350–2400 m.

Potentilla arguta Pursh var. *convallaria* (Rydb.) T. F. Wolf: 1; CO (7561); mog-lac; 2250–2300 m.

Potentilla concinna Richardson var. *concinna*: 2; CO (3350), MO (3354); mog, rip; 2450–2650 m.

Potentilla fruticosa L.: 1; CO (6686); rip; 2400–2450 m.

Potentilla gracilis Douglas ex Hook. var. *pulcherrima* (Lehm.) Fernald: 4; CO (7485); rip, mog-lac, pmg, oaw; 1950–2450 m.

Potentilla hippiana Lehm. var. *hippiana*: 6; CO (7448), MO (8828); ppw, rip, mog-lac, mog-rip, rds; 1550–2600 m.

Potentilla norvegica L. subsp. *monspeliensis* (L.) Asch. & Graebn.: 5; CO (7150), MO (8562), SM (7049), UN (7373 B); ari, rip, rip-ppw; 1550–2350 m.

Potentilla paradoxa Nutt.: 1; SM (7048); ari; 2000–2050 m.

Potentilla pensylvanica L. var. *pensylvanica*: 3; CO (7883), MO (6353), UN (5181); 1550–2300 m.

Potentilla rivalis Nutt. var. *millegrana* (Engelm. ex Lehm.) S. Watson: 9; HA (5413), MO (6379) SM (3816), UN (5778); mxs, rip, rip-pmg, ari, pjw; 1300–1950 m. Specimens collected from sandy soils.

Potentilla subviscosa Greene: 1; SM (3739); pjw; 1900–1950 m.

Prunus americana Marshall: 5; CO (1833), HA (8312), UN (4238); rds, pmg, rip-oaw, ppw, mcw-rip; 1300–2350 m.

Prunus virginiana L. var. *melanocarpa* (A. Nelson) Sarg.: 14; CO (5291), HA (443), MO (4722), UN (4224); oaw, ppw, rip, rip-ppw, oaw-rip, mog-lac, rds, mcw, ppw-pjw, mog-rip, mcw-rip; 1700–2450 m.

Rosa arkansana Porter var. *arkansana*: 1; UN (4189); rds-riw; 1879 m.

Rosa woodsii Lindl. var. *ultramontana* (S. Watson) Jeps.: 16; CO (6715), HA (5455), MO (8827), SM (3711), UN (1729); rip-ppw, oaw-rip, rip, rds, mog-lac, ppw, mog-rip, pjw, rip-pmg, oaw; 1550–2500 m.

SR ! *Rosa* x *harisonii* Rivers: 1; CO (4651); pmg; 1750–1800 m. According to Kartesz (pers. comm., 2008), the nearest collections of this escaped ornamental are Uintah Co., UT, and Mahaska Co., IA.

Rubus deliciosus Torr.: 2; SM (3733); pjw, rip-pmg; 1900–2250 m.

* *Rubus* aff. *idaeus* L.: 1; SM (BR-3227); 2500–2700 m.

Rubus idaeus L. var. *strigosus* (Michx.) Maximowicz: 1; CO (6683); rip; 2400–2450 m. [=*R. i.* var. *aculeatissimus* Regel & Tiling]

Rubus neomexicanus A. Gray: 3; SM (3706), UN (4208); pjw, mcw-rip, rip-oaw; 1900–1950 m.

* *Rubus* aff. *neomexicanus* A. Gray: 1; SM (3705 B); pjw; 1900–1950 m.

Rubus parviflorus Nutt. var. *parviflorus*: 1; HA (DH-11715); 1750–1800 m.

Rubiaceae

Galium aparine L.: 1; CO (7880), SM (3810); rip, pmg; 1350–1600 m.

Galium boreale L.: 10; CO (7881), SM (BR-6980), MO (6400), UN (5171); rip-ppw, rip, mog-lac, ppw, mcw-rip; 1550–2450 m.

Galium mexicanum Kunth var. *asperrimum* (A. Gray) Higgins & S. L. Welsh: 6; CO (5283), HA (5430); SM (3864); UN (4212); oaw-rip; rip-ppw, mog-lac, mxs, rip-pmg; 1450–2400 m.

Galium triflorum Michx.: 1; SM (BR-4212); 2500–2600 m.

Hedyotis nigricans (Lam.) Fosberg var. *nigricans*: 9; HA (8260), QU (2677), UN (1952); pmg, mxs, rds, rip-pmg, ari; 1300–1750 m.

Houstonia rubra Cav.: 1; SM (NS-9875); pjw; 1600–1650 m.

Ruscaceae

Maianthemum racemosum (L.) Link var. *amplexicaule* (Nutt.) Dorn: 1; CO (7575); mog-lac; 2250–2300 m.

Maianthemum stellatum (L.) Link: 5; CO (4668), MO (4734); rip-ppw, oaw-rip, mcw-rip, mog-rip; 1800–2600 m.

Nolina texana S. Watson: 8; HA (6585), MO (DH-12148), SM (8165); rip, mxs, pjw, rsl-riv, rds; 1450–1650 m. Disagreement persists as to whether this is distinct from *N. greenei* S. Wats. ex Trealease.

Rutaceae

Ptelea trifoliata L.: 5; HA (8393), MO (509), QU (NS-9735); pmg, rip, pjw-row, pjw-mxs; 1150–1800 m.

Salicaceae

* *Populus* aff. *x acuminata* Rydb.; 1; HA (DH-H2006-01); rip; 1675 m.

Populus angustifolia E. James: 1; SM (BR-8670); 2650–2700 m.

Populus deltoides W. Bartram ex Marshall var. *occidentalis* Rydb.: 14; CO (5331), HA (NS-9440), QU (NS-9694), UN (2442); rip, pmg, lac, oaw, ari, rip-pmg, rds; 1300–2000 m. Collections of Hazlett (DH-2006-01 through 04) in Mills Canyon, Harding County, may represent hybridization between *P. deltoides* and *P. angustifolia*.

Populus tremuloides Michx.: 3; CO (6645), UN (4256); rip, mcw-rip, rip-oaw; 1900–2450 m.

Salix amygdaloides Andersson: 10; CO (5266), HA (DH-2006-07), MO (4744), QU (NS-9689), SM (3822), UN (5614); mcw-rip, mog-rip, rip-pmg, riw, rip-oaw, pmg; 1150–2300 m.

* *Salix* aff. *amygdaloides* Andersson: 2; UN (7399); ari; 1550–1600 m.

& *Salix arizonica* Dorn: Not collected but known from study area in Mora county (Tables 10, 11).

Salix bebbiana Sarg.: 1; SM (4156); 2600–2700 m.

Salix exigua Nutt. var. *exigua*: 31; CO (5265), HA (5369), MO (8816), SM (4814), UN (5169); mcw-rip, rip-ppw, mog-lac, mog-rip, rip, pmg-lac, ppw, mxs, ppw-pjw, pmg, ozw, ari, rip-oaw, riw, rds, pmg-rip; 1350–2500 m.

Salix exigua Nutt. var. *pedicellata* (Andersson) Cronquist: 3; HA (6596), UN (6823); rip, riw, ari; 1350–1600 m.

Salix lasiandra Benth. var. *caudata* (Nutt.) Sudw.: 1; HA (NS-9488); rip; 1600–1700 m. [=*S. lucida* Muhl. subsp. *caudata* (Nutt.) E. Murray]

Santalaceae

Arceuthobium vaginatum (Willd.) J. Presl var. *cryptopodium* (Engelm.) Cronquist: 1; MO (4778); lac; 2400–2450 m.

Comandra umbellata (L.) Nutt. var. *pallida* (A. DC.) M. E. Jones: 4; CO (4690), HA (NS-9517), SM (3885), UN (3561); rip-ppw, pjw, rip-pmg, pjw-pmg; 1400–1850 m.

Phoradendron juniperinum Engelm.: 3; SM (4818); mxs, rip; 1750–1900 m.

Sapindaceae

Acer glabrum Torr. var. *glabrum*: 1; CO (6643); rip; 2400–2450 m.

? *Acer* aff. *negundo* L.: 1; MO (DH-12115); 1500–1600 m.

Acer negundo L. var. *interius* (Britton) Sarg.: 1; SM (NS-9848); rip; 1800–1850 m.

Acer negundo L. var. *violaceum* (Kirchn.) Jaeger: 1; HA (8392); rip; 1450–1500 m.

Sapindus saponaria L. var. *drummondii* (Hook. & Arn.) L. D. Benson: 1; HA (DH-11725); 1500–1600 m.

Saururaceae

Anemopsis californica Hook. & Arn.: 1; SM (6294); rip-pmg; 2200–2250 m.

Saxifragaceae

Heuchera parvifolia Nutt. ex Torr. & A. Gray: 4; CO (4686), MO (4763); UN (5150); 1800–2450 m.

Saxifraga bronchialis L. var. *austromontana* (Wiegand) Piper ex G. N. Jones: 1; CO (6637); rip; 2400–2450 m.

Scrophulariaceae

Scrophularia lanceolata Pursh: 1; CO (7491); mog-lac; 2250–2300 m.

! *Verbascum thapsus* L.: 27; CO (6674), HA (7750), MO (8561), SM (7110), UN (7406); rip, rds, ppw, mog-lac, pjw, pmg, fog-ari, ari, pmg-rip, oaw; 1350–2500 m.

Simaroubaceae

! *Ailanthus altissima* (Mill.) Swingle: 1; HA (NS-9457); rsl-riw; 1550–1600 m.

Solanaceae

Calibrachoa parviflora (Juss.) D'Arcy: 1; CO (9033); lac; 1800–1850 m.

Chamaesaracha conioides (Moric.) Britton: 22; HA (4309), QU (2674) SM (3775); UN (5792); pmg, pmg-pjw, rds, mxs, rip-pmg, pjw, pmg-rsl, ppw; 1150–1550 m.

Chamaesaracha coronopus (Dunal) A. Gray: 11; HA (5376), UN (2057); mxs, pmg-pjw, rip-pmg, pmg, rds, pmg-pjw, rip; 1350–1850 m.

! *Datura quercifolia* Kunth: 2; HA (8329), UN (2658); pmg; 1300–1500 m.

! *Datura stramonium* L.: 1; UN (590); pmg; 1400–1450 m.

Lycium pallidum Miers: 2; HA (NS-9526), MO (7833); pmg; 1550–1850 m.

Physalis hederifolia A. Gray: 1; SM (4826); mxs; 1750–1800 m.

Physalis hederifolia A. Gray var. *comata* (Rydb.) Waterf.: 4; HA (5907), UN (7972); pmg, oaw, rip-pmg; 1550–1750 m.

Physalis hederifolia A. Gray var. *fendleri* (A. Gray) Cronquist: 3; HA (7734), UN (2429); rip, pjw, mxs; 1350–1800 m.

* *Physalis* aff. *heterophylla* Nees: 1; UN (5781), rip-pmg; 1300–1350 m.

Physalis hispida (Waterf.) Cronquist: 7; HA (5076), UN (5572); pmg; pmg-rip; 1300–1550 m.

Physalis virginiana Mill.: 7; HA (8389), MO (8519), UN (1732); rip, ari, rds, rip-row; 2350–2000 m.

Quincula lobata (Torr.) Raf.: 24; CO (4267), HA (4366), QU (9791), UN (2211); lac, pmg-pjw, rip-pmg, pmg-lac, mxs, rds, fog, pmg, ppw; 1150–2200 m.

Solanum americanum Mill.: 1; UN (8051); oaw; 1550–1600 m. A reviewer suggests the identify of this specimen is *S. nigrum* L., which if correct means it is introduced.

Solanum elaeagnifolium Cav.: 88; HA (4365), MO (4548), QU (2680), SM (2295), UN (5231); rip-pmg, pmg, mxs, pmg-pjw, rip, pal, pjw, rds, ari, fog-ari, riw, pmg-rsl, rsl-riw; 1150–1900 m.

Solanum rostratum Dunal: 48; HA (8620), QU (2694), SM (8923), UN (7634); pmg, pjw, mxs, rds, fog-ari, riw, pmg-rip, pmg-rsl, pmg-pjw, fog, row; 1300–2050 m.

Tamaricaceae

!! *Tamarix ramosissima* Ledeb.: 32; CO (5357), HA (5423), MO (7794), QU (4505), SM (6028), UN (5775); lac, ari, ppw, rip, mxs, rip-pmg, pmg, ari, rds, riw, rip-row; 1150–2050 m.

Theophrastaceae

Samolus floridanus Kunth: 1; HA (8293 B); pmg; 1300–1350 m.

Typhaceae

Typha angustifolia L.: 10; CO (5363), HA (8383), MO (8587), UN (1912); lac, rip-pmg, rip, ppw-pjw, oaw, rds; 1300–1850 m.

* *Typha* aff. *angustifolia* L.: 2; HA (481), SM (8110); ppw-pjw, pmg-rip; 1400–1750 m.

Typha latifolia L.: 3; MO (8848), SM (7037); rip, fog-ari, ari; 2000–2500 m.

Ulmaceae

!! *Ulmus pumila* L.: 5; MO (7834), SM (7103), UN (3949); pmg, ari, rip; 1250–2050 m.

Urticaceae

Urtica dioica L. var. *procera* (Muhl. ex Willd.) Wedd.: 7; CO (5255), MO (8821), UN (8020); mcw-rip, mog-lac, rip, rip-ppw, oaw, ari; 1550–2500 m.

Verbenaceae

Glandularia bipinnatifida (Nutt.) Nutt. var. *bipinnatifida*: 91; CO (4273), HA (5910), MO (2232), QU (2668), SM (4516), UN (5218); lac, fog, pmg, pmg-lac, mxs, rds, pmg-pjw, rip-pmg, pjw, mxs-lac, rip, ppw, ari, fog-ari, oaw, rsl, row, pjw-oaw; 1150–2200 m.

Glandularia bipinnatifida (Nutt.) Nutt. var. *ciliata* (Benth.) B. L. Turner: 3; SM (7053), UN (4089); ari, rds, pjw; 1600–2050 m.

Phyla cuneifolia (Torr.) Greene: 18; CO (4653), HA (4362), SM

(7111), UN (5660); pmg, ari, rip-pmg, mxs, rip, pjw, riw, pmg-pjw; 1350–2050 m.

! *Phyla nodiflora* (L.) Greene: 2; SM (5974); ari, mxs; 1250–1300 m.

Verbena bracteata Lag. & Rodr.:19; CO (9016), HA (4581), MO (8520), UN (7379); lac, rds, pmg-lac, pjw, rip, pmg, rip, ari, pmg-rip, rip-row; 1300–2500 m.

Verbena macdougalii A. Heller: 7; CO (7915), MO (8837), SM (8958), UN (1781); rip, mog-lac, mog-rip, fog-ari, ari, rds; 1550–2600 m.

Verbena plicata Greene: 2; HA (7724), SM (5918); pjw, rds; 1400–1800 m.

Violaceae

Hybanthus verticillatus (Ortega) Baill.: 1; HA (6563); rip; 1550–1600 m.

Viola canadensis L.: 4; CO (5245); mcw-rip, rip-ppw, oaw-rip, oaw; 1800–2400 m.

Viola nuttallii Pursh: 5; CO (5297), UN (4216); oaw-rip, mcw-rip, mcw, oaw; 1900–2400 m.

Viola pedatifida G. Don: 3; CO (5288); oaw-rip, mcw-rip, mcw; 2250–2450 m.

Vitaceae

Parthenocissus vitacea (Knerr) Hitchc.: 13; CO (4691), HA (7242), MO (8533), SM (6144), UN (5167); rip-ppw, ppw, rip-pmg, ppw-pjw, rip, pmg, oaw, pjw, mcw-rip; 1350–2250 m.

Vitis acerifolia Raf.: 5; HA (528), SM (3705 A), UN (5551); pjw, rip-pmg, rds; 1400–2250 m.

* *Vitis* aff. *acerifolia* Raf.: 1; HA (8473); rip; 1450–1500 m.

Zygophyllaceae

Kallstroemia parviflora Norton: 1; HA (DH-12149); 1500–1600 m.

Krameria lanceolata Torr.: 13; HA (5034), QU (4470), SM (6016), UN (6880); pmg, mxs, ari, pjw, pmg-rip; 1150–1550 m.

! *Tribulus terrestris* L.: 6; HA (8330), SM (8114), UN (1027); pmg, rip; 1300–1550 m.

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BOOK NOTICE

David S. Ingram, Daphne Vince-Prue, and Peter J. Gregory (eds). 2008. **Science and the Garden, the Scientific Basis of Horticultural Practice, 2nd Edition.** (ISBN 978-1405160636, pbk.). Wiley-Blackwell Publishing, 10475 Crosspoint Boulevard, Indianapolis, Indiana 46256, U.S.A. (**Orders:** www.wiley.com, 877-762-2974). $49.99, 368 pp., 135 illustrations, 7 1/2" × 9 3/4".

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The coverage is wide-ranging and comprehensive and includes the basic structure and functioning of garden plants, nomenclature, genetics and plant breeding, soil management, environmental factors affecting growth, methods of propagation and production, pest and disease control, post harvest management and storage, and conservation and sustainable horticulture.

Now with full colour throughout, the second edition provides the reader with completely revised and updated chapters from the first edition, with new information and clearer focus on the topics, and four new chapters, dealing with matters that have become of increasing concern since the first edition, namely: Diversity in the Plant World; Conservation and Sustainable Gardening; Gardens and the Natural World; and Gardens for Science."

CHECKLIST OF THE VASCULAR PLANTS OF FAYETTE COUNTY, PENNSYLVANIA

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ABSTRACT

Fayette County has been botanized since the early 1800s; however, a checklist of the county's vascular flora has not previously been compiled. A search of herbaria augmented by targeted fieldwork has resulted in a list of 1,249 taxa of native and naturalized plants comprising 525 genera and 134 families. The six families with the largest number of species are Asteraceae, Poaceae, Cyperaceae, Rosaceae, Fabaceae and Lamiaceae. *Carex*, *Viola*, *Rubus*, *Polygonum* and *Solidago* are the five largest genera. There are approximately 201 non-native species that have been introduced mainly from Europe and Eurasia. This checklist recognizes 10 species of Lycophytes, 2 species of Equisetophytes, 42 species of Polypodiophytes, 10 species of Gymnosperms, and 1,149 species of Angiosperms. Eighty-five species have global or state ranking.

RESUMEN

El condado de Fayette County ha sido herborizado desde el comienzo de los 1800s; sin embargo, no ha sido compilado previamente un listado de la flora vascular del condado. Una búsqueda en los herbarios incrementada con trabajo de campo dirigido ha dado como resultado una lista de 1,249 taxa de plantas nativas y naturalizadas que comprenden 525 géneros y 134 familias. Las seis familias con el mayor número de especies son Asteraceae, Poaceae, Cyperaceae, Rosaceae, Fabaceae y Lamiaceae. *Carex*, *Viola*, *Rubus*, *Polygonum* y *Solidago* son los cinco mayores géneros. Hay aproximadamente 201 especies no nativas que han sido introducidas principalmente de Europa y Eurasia. Este listado reconoce 10 especies de Lycophytos, 2 especies de Equisetophytos, 42 especies de Polypodiophytos, 10 especies de Gimnospermas, y 1,149 especies de Angiospermas. Ochenta y cinco especies tienen rango global o estatal.

Site Description

Fayette County, Pennsylvania, is located in the southwestern corner of the state (Fig. 1). It is bordered by Westmoreland County to the north, Somerset County to the east, Washington and Greene Counties to the west, and the states of West Virginia and Maryland to the south. The entire western boundary of the county is the Monongahela River. The Youghiogheny River enters on the southwestern side of Pennsylvania on the border between Fayette and Somerset counties and flows northwest through a gap in the Chestnut Ridge to Connellsville and then to McKeesport.

Fayette County receives total annual precipitation of approximately 39 inches along the Monongahela River to 42 inches at the higher elevations of Chestnut Ridge and Laurel Hill. The precipitation is usually well distributed throughout the year with February usually the driest month and June the wettest. Average seasonal snowfall is 31 inches annually with the ground being snow-covered about 30 days per year.

The average date of the last 32 degree temperature in the spring is usually April 28th, and the first frost of the season is October 14th. The length of the growing season, from the last killing frost in spring to the first killing frost in autumn, is about 169 days (Uniontown, Fayette County Climate, www.ems.psu.edu/PA_Climatologist/uniontown).

Sophie's Woods within Friendship Hill National Historic Site has been reported by Jeffrey D. Wagner and Robert Coxe of the Western Pennsylvania Conservancy as an old growth red oak-mixed hardwood forest. In their own words, "Forests of such maturity are unusual for the county and the region in general. Dominants include red oak (*Quercus rubra*), white oak (*Q. alba*), scarlet oak (*Q. coccinea*), tulip tree (*Liriodendron tulipifera*), and shagbark hickory (*Carya ovata*). Major shrubs include mountain laurel (*Kalmia laifolia*), spicebush (*Lindera benzion*), and American witchazel (*Hamamelis virginiana*). Herbs in this forest are sparse

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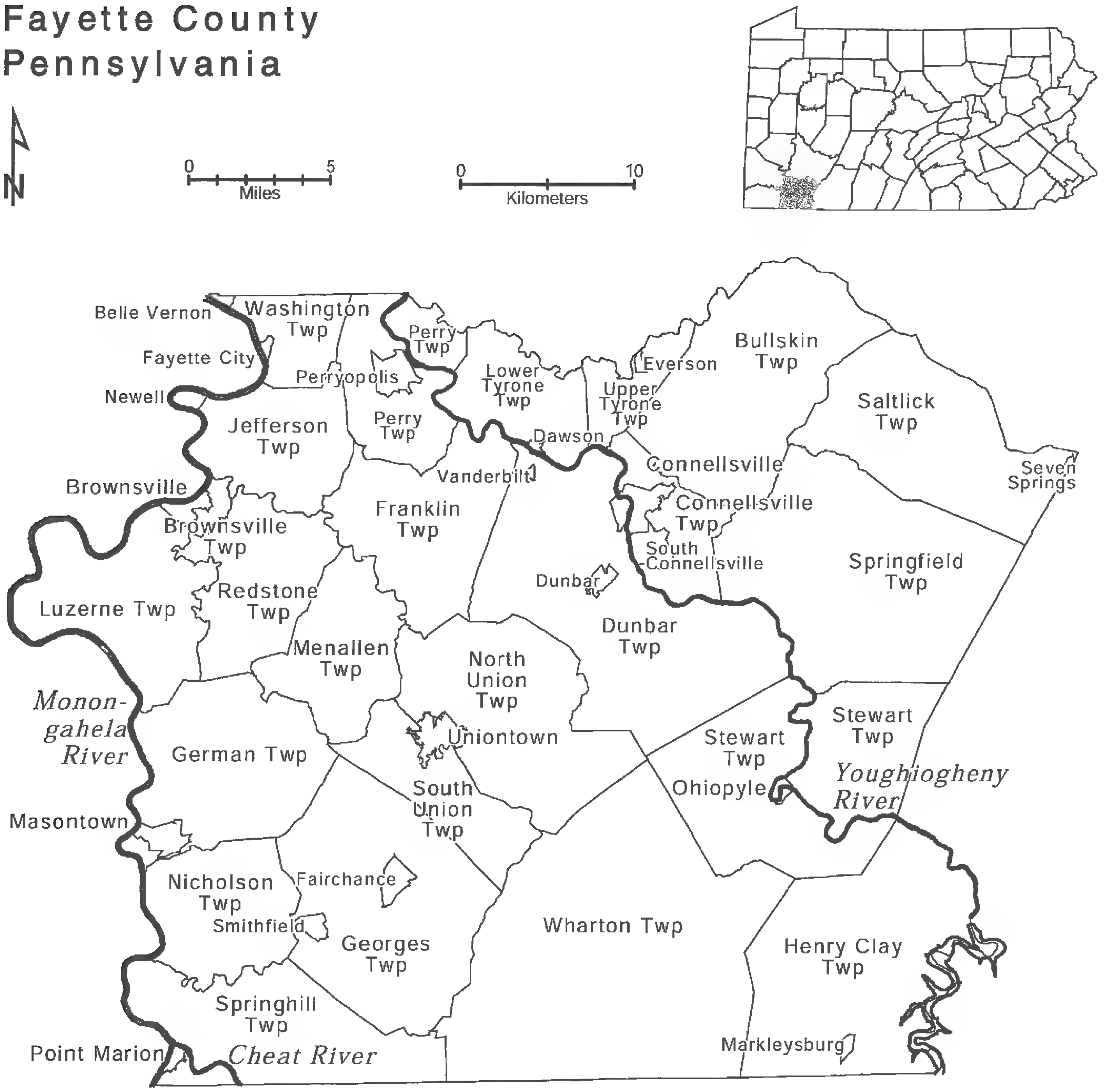
J. Bot. Res. Inst. Texas 2(2): 1449 – 1474. 2008


Fayette County
Pennsylvania
N
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Belle Vernon
Washington Twp
Fayette City
Perry Twp
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Newell
Jefferson Twp
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Lower Tyrone Twp
Upper Tyrone Twp
Everson
Bullskin Twp
Saltlick Twp
Dawson
Vanderbilt
Connellsville
Seven Springs
Brownsville
Brownsville Twp
Franklin Twp
Connellsville Twp
South Connellsville
Springfield Twp
Dunbar
Luzerne Twp
Redstone Twp
Dunbar Twp
Menallen Twp
North Union Twp
Monongahela River
Uniontown
Stewart Twp
Stewart Twp
German Twp
Ohiopyle
Youghiogheny River
South Union Twp
Masontown
Nicholson Twp
Fairchance
Smithfield
Georges Twp
Wharton Twp
Henry Clay Twp
Springhill Twp
Point Marion
Cheat River
Markleysburg

Fig. 1. Small map contains counties in Pennsylvania. Larger map consists of municipalities and major rivers of Fayette County.

mainly composed of Virginia creeper (*Parthenocissus quinquefolia*), round-leaved violet (*Viola rotundifolia*), false solomon's seal (*Smilacina racemosa*), and sessile bellflower (*Uvularia sessilifolia*). Save for the conspicuous absence of American chestnut (*Castanea dentata*), this forest is probably similar to those forests seen by Albert Gallatin when he lived here and George Washington when he surveyed the area" (Wagner & Coxe 2000).

Ferncliff Peninsula is a unique habitat encompassing a 100-acre peninsula with many rare and unusual plants for Pennsylvania. The Youghiogheny River brings seeds from West Virginia and Maryland into the gorge that is warmer than the surrounding area, allowing plants to grow in areas where they normally would not occur. The area was designated as a National Natural Landmark by the U.S. Congress in 1973 and was named a State Park Natural Area in 1992. The peninsula is shaded by oaks, hickories, tulip trees, and beech. Rare plants include: Barbara's buttons (*Marshallia grandiflora*), Carolina tassel-rue (*Trautvetteria caroliniensis*), Slender blue iris (*Iris prismatica*), Autumn willow (*Salix serissima*), and buffalo-nut (*Pyrularia pubera*). In addition, plant fossils such as *Lepidodendron* from 365-million-year-old club mosses are plentiful.

Boulders from the size of basketballs to houses occur on the waterfront while white waters make it one of the most scenic of all Eastern riverfronts (Palmer 1984).

The soils of the county consist of five main series: Gilpin-Wharton-Ernest association, Guernsey-Westmoreland-Clarksburg association, Dekalb-Hazleton-Cookpart association, Upshur-Albrights association, and Monongahela-Philo-Atkins association (Kopas 1991).

The Gilpin-Wharton-Ernest association is widely distributed. In the east it occupies the areas between Chestnut Ridge and Laurel Hill, while in the west it extends from Point Marion to Perryopolis and from Point Marion to Laurelville. These soils are deep and moderately to well-drained. They consist of level to very steep soils underlain by acid shale and some sandstone bedrock on uplands. This soil association makes up about 37 percent of the county. Portions of this association are strip-mined producing highly acidic soils, however, this association also has some of the better farming soils of the county.

The Guernsey-Westmoreland-Clarksburg association consists of rounded hilltops and a series of benches located along the slopes. These soils are deep and poorly to well-drained. They consist of moderately steep soils influenced by limestone strata in the bedrock on uplands with medium to moderately fine texture. This soil association makes up about 27 percent of the county. Areas of strip mine spoil, mine dumps, and urban land occur. Dairy and general farming are dominant.

The Dekalb-Hazleton-Cookpart association is located on and along Chestnut Ridge and Laurel Hill and along the Youghiogheny River. Most of the association is very stony. These soils are moderately deep to deep and moderately to well-drained. They are coarse to medium in texture and level to very steep soils underlain by bedrock that is dominantly acid sandstone on uplands. This soil association makes up about 25 percent of the county. Most of this association contains forestland.

The Upshur-Albrights association consists of soils formed in materials weathered from red shale, limestone, and some sandstone. It occurs along the upper slopes of Chestnut Ridge and Laurel Hill. These soils are deep and poorly to well-drained and occur on gently sloping to very steep uplands. This soil association makes up about 7 percent of the county. Much of this association is forested with a few large stone quarries present.

The Monongahela-Philo-Atkins association consists of soils formed in deep alluvial deposits that are common along the Monongahela and Youghiogheny Rivers. These soils are deep and moderately to poorly drained and are nearly level to sloping soils on stream terraces and flood plains. This soil association makes up about 4 percent of the county. Parts of this association contain the county's community and industrial development (Kopas 1991).

Fayette County is situated in the Laurel Highlands of southwestern Pennsylvania; the terrain consists of rolling hills and mountains. The eastern part of Fayette County is mountainous with Chestnut Ridge rising to heights of more than 2,900 feet. The west of Chestnut Ridge is a rolling and hilly plateau. Much of Fayette County was once underlaid by coal but most of it has been mined. Elevations range from a high of 2,900 feet to a low of 290 feet above sea level.

All of Fayette County is in the Monongahela River watershed, which is part of the Ohio and Mississippi River watersheds. Two of the principal tributaries of the Monongahela River, the Youghiogheny and Cheat Rivers, flow through Fayette County.

The Monongahela subbasin has a total drainage area of 2737 square miles. It includes the Pennsylvania portion of the Monongahela River, from West Virginia and Maryland to Pittsburgh. The Pennsylvania portion of the subbasin encompasses all of Fayette County, and parts of Greene, Washington, Westmoreland, and Somerset Counties.

The Monongahela subbasin in Fayette County is divided into the following major watersheds: Lower Youghiogheny River, Middle Monongahela River, Upper Monongahela River and the Upper Youghiogheny River watersheds.

The Lower Youghiogheny River watershed has a total drainage area of 478 square miles and its major streams include Sewickley Creek, Jacobs Creek and the lower portion of the Youghiogheny River. The Middle

Monongahela River watershed has a total drainage area of 509 square miles and its major streams include the middle portion of the Monongahela River, Pigeon Creek and Redstone Creek.

The Middle Monongahela Watershed shows many extremes in water quality due to both man-made and natural causes. The greatest water problem is the pollution of the water resources by the drainage from coal mining operations, and the hundreds of abandoned oil and gas wells that are not properly sealed.

The Upper Monongahela River has a total drainage area of 377 square miles and its major water ways include Whitely Creek, Dunkard Creek, and the uppermost Pennsylvania portion of the Monongahela River. The Upper Youghiogheny River has a total drainage area of 384 square miles and its major streams include the Indian Creek, Laurel Hill Creek and the upper portion of the Youghiogheny River.

Watershed conditions need to be evaluated to detect if biodiversity is increasing or decreasing in these areas. Such comparisons will be extremely important in mining sites because they will reflect the interactions of many of the other indicators such as pollution and soil changes, which can be utilized to make better management decisions (Pennsylvania DEP Watershed Notebook 2006).

History

Early Indian traders, land agents, and explorers were the first Europeans to blaze the way into Fayette county. In the mid-18th century, rivers were the only easily accessible means of transportation upon which the French took routes down from Canada. In 1754, George Washington led an expedition into the region which ended in defeat by the French and Indians at Fort Necessity. In 1758 after the British won the French and Indian War, settlers came back into the region to initiate subsistence farming. The Braddock Road from Cumberland northward from Fort Necessity down to Gist Plantation and on through Connellsville were the main roads in Fayette. A connector was needed to the west and Col. Burd supplied that in 1759, with the help of the Indian chief Nemacolin. The connector was from Gist's Plantation to Brownsville. These routes provided the basic network that the National Road would later follow.

In the 1770s, the territory that would become Fayette County was claimed by both Pennsylvania and Virginia. The claim was finally settled in 1780 when the Mason-and-Dixon Line was extended to the original limit of Pennsylvania's land grant, giving Virginia frontage on the Ohio River.

Fayette County was created in September 1783 from the southern portion of Westmoreland County. The county was named for Marquis de la Fayette, a young Frenchman who assisted Gen. George Washington during several major battles of the American Revolution.

Fayette County's geographic location and the wealth of its natural resources are collectively responsible for producing two major historical periods. The first is the transportation via "road and river era" and the second is the "coal and coke era."

Industrialization came at the turn of the 19th century with iron furnaces being built in the mountains to harvest deposits of iron ore and to utilize the surrounding forest as a wood source for charcoal. The glass industry was first established when Albert Gallatin opened his New Geneva glassworks in 1794. Within the next 20 years, numerous glass factories were erected at various points along the river, which brought national recognition to the upper Monongahela River valley. The National Road, built in 1815 opened up the Northwest Territory, allowing travel into areas that were previously inaccessible by river.

Vast deposits of bituminous coal underlying much of Fayette County resulted in the development of an internationally renowned coal and coke industry around the turn of the 20th century. Thousands of European immigrants came to Fayette County to work in the mines. However, by the 1950s most of the large Fayette County mines were finished and the county's economy took a major downward turn. Tourism and industrialization are the current growth prospects.

The county is divided into 42 municipalities with the majority of the population residing in the urban and suburban areas. The first census taken in 1790 documented that Fayette County had a population of nearly 13,325. As of 2000, the population was 148,644. According to the U.S. Census Bureau, the county has a total area of 2,067 km^2 (798 mi^2), 2,046 km^2 (790 mi^2) of it is land and 20 km^2 (8 mi^2) is water (U.S. Census Bureau 2007).

Major Collectors

Collecting in Fayette County for the Carnegie Museum Herbarium began in the early 1800s and has continued to the present. Most of the collectors have been members of the Botanical Society of Western Pennsylvania and the staff of the Section of Botany at Carnegie Museum. Botanists who have made significant contributions to the knowledge of the Fayette County are J. Bright, W.E. Buker, R. Coxe, L.K. Henry, O.E. Jennings, J.A. Shafer, and L. Speedy.

METHODS

This checklist was compiled by searching the herbarium of the Carnegie Museum of Natural History (CM), Academy of Natural Sciences of Philadelphia (PH) and John Franklin Lewis Herbarium at the California University of Pennsylvania (CUP). Herbarium collection information was obtained from the Morris Arboretum (MOAR). Six specimens were examined and included from the Academy of Natural Sciences of Philadelphia (PH) and six specimens from the John Franklin Lewis Herbarium at the California University of Pennsylvania (CUP). Fieldwork was conducted targeting underrepresented areas of the county. Most of the collections were made during the last two years, but some date from the late 1940s and early 1950s, and a few are from 1873 and 1883. Rhoads and Block (2007) was the primary source for plant identification. For generic and species names, we have generally followed Kartesz (1999). Authorities are abbreviated according to Brummitt and Powell (1992).

RESULTS AND DISCUSSION

This list includes the names of all native and naturalized species known to occur in Fayette County. It includes a total of 134 families, 525 genera, and 1213 species. The number of families, genera, species and non-native are similar to the recently reported taxa for Crawford, Greene and Washington Counties (Table 1). The six families with the largest number of species are Asteraceae, Poaceae, Cyperaceae, Rosaceae, Fabaceae and Lamiaceae. *Carex*, *Viola*, *Rubus*, *Polygonum*, and *Solidago* are the largest genera. This checklist recognizes 10 species of Lycophytes, 2 species of Equisetophytes, 42 species of Polypodiophytes, 10 species of Gymnosperms, and 1,149 species of Angiosperms. There are approximately 201 non-native species that have been introduced mainly from Europe and Eurasia. Eighty-five species have global or state ranking. Of the 85 plants that have global or state ranking, four, including, *Aconitum reclinatum*, *Delphinium exaltatum*, *Scutellaria saxatilis*, and *Vitis rupestris*, have a global ranking of G3 or vulnerable status. Three plants, *Marshallia grandiflora*, *Potamogeton tennesseensis*, and *Spiraea virginiana*, have a global ranking of G2, and one, *Malaxis bayardii*, is globally ranked as G1G2. The remaining 85 plants are either a G4 or G5 status, indicating an apparently secure or secure condition globally.

Aconitum reclinatum belongs to the buttercup family. It is a perennial herb from fascicled roots, with cauline leaves that are deeply divided and coarsely toothed. The flowers are white, grouped in an inflorescence at the end of the stem and lack spurs. White monkshood flowers from June to September. There are only two species of *Aconitum* in Pennsylvania. The second species, *A. uncinatum* has blue flowers, therefore white monkhood is easy to identify when in flower. It grows in moist areas along streams, in coves, or in seeps within mixed forests. It is threatened by logging activity and may be disturbed by drainage or disturbance of wetland habitats.

Delphinium exaltatum has alternate leaves that are palmately divided into 3–5 segments, 15 cm long, silvery-green abaxially and pubescent above and below. The basal lobes of some of the larger leaves are divided again and make the blade appear 5-lobed. The flowers are in terminal racemes. The 4 purplish-blue petals are dimorphic with the upper two expanded at the base and forming a spur. The lateral petals are reflexed and have long white hairs. The stamens are approximately 30 in number with yellow pollen. The 5 sepals of this plant are irregular. This species is readily confused with another similar taxon, *Delphinium tricorne*, however *D. tricorne* is a smaller plant, which flowers much earlier than *D. exaltatum*). By July, when *D. exaltatum* is beginning to flower, *D. tricorne* has already set fruit. Most of the collections are from rich

TABLE 1. Recent checklists produced since 2005, including total number of speices, families, genera; non-native and global rare species found.

	Total	non-native	Families	Genera	Rare G1-3
Crawford[1]	1168	208	134	485	3
Fayette	1214	201	134	522	8
Greene [2]	890	179	118	438	1
Washington[3]	982	203	125	472	1

[1]Morton, Speedy and Bissell (2007), [2]Coxe, et al. (2005), and [3]Morton and Speedy (2007).

shaded woods and rocky limestone bluffs. This species is quite conspicuous and may be subject to casual picking or dug for gardens.

Scutellaria saxatilis is a member of the mint family. The genus *Scutellara* is very distinctive and easily identified by the protuberance on the upper lip of the corolla. This species is a stoloniferous plant with upper cauline leaves that are broadly lanceolate to triangular, and cordate at the base. The leaves are coarsely crenate, 4–5 cm long, with a long petiole. The flowers of *S. saxatilis* are in panicles. Most of the collections are from semi-shaded areas in dry woods or, occasionally, in moist areas along streams. This species is not common, and due to its inconspicuous nature it may be overlooked. Its recovery potential is unknown.

Vitis rupestris is a member of the grape family. It is a bushy shrub-like grape that is seldom climbing. Tendrils are lacking or if present, reddish and only found on the uppermost nodes. The leaves are reniform, coarsely toothed and pubescent below, usually along the veins. The pith is interrupted by a diaphragm at each node. The *V. rupestris* flowers from early April to mid-June. Fruits are black berries. It grows in sandy deposits on rocky river banks.

The Large-flowered Marshallia, *Marshallia grandiflora*, is in the family Asteraceae. The leaves are narrow and tapering with three parallel veins. Near the base the leaves are petiolate, but near the apex the leaves are sessile. The flowers are small tubular, white or light blue, and clustered in disc-shaped heads at the apex of each main stem. Marshallia grows in wet forests or meadows and on stream banks throughout central Appalachia and into the southern Appalachians from southern Pennsylvania to Eastern Tennessee. It is a perennial herb flowering from early June to late July.

Potamogeton tennesseensis is a submersed and floating-leaved aquatic with very slender, terete stems. The floating leaves are about 2–4 cm long and 5–13 mm wide while the submersed leaves are 0.2–2 mm wide with 1–3 major veins. The overall small size of *P. tennesseensis*, in combination with the acute floating leaves, render the species reasonably distinctive from other *Potamogeton* species. The species flowers from May through September and fruits from July to October. The species occurs in ponds and streams.

The Appalachian spiraea, *Spiraea virginiana*, is in the Rosaceae. It is a clonal shrub reaching a height of 3 meters. The leaves are long, narrow, and taper to the base with nearly smooth edges. They are whitish underneath. The flowers are small with 5 white petals. The flowers are grouped into large showy clusters, up to 5 inches wide at the end of the stems. *Spiraea virginiana* flowers from late June to early July and fruits from July into early September. It typically grows along gravel bars and banks of swift flowing streams and scoured river banks that experience periodic flooding. The species is currently known from seven states from Pennsylvania to Alabama. It has become so rare and individual populations are so isolated that it is not known to set fertile seed due to lack of cross-pollination.

Malaxis bayardii, Bayard's adder's mouth, is one of the smallest of our native orchids. There are only about a half dozen known populations of this plant worldwide. The orchid has been reported to occur in dry, open woods, shale barrens and sandy pine barrens. The plant flowers from mid-July to August with fruits persisting into September. It is about 4 to 8 inches tall with one oval green clasping leaf. At the top of the stem is a spike of about 150 tiny yellow-green flowers that mature from the top down. The lip petal is divided into two lobes. *Malaxis unifolia* is similar in appearance but is typically found in swamps, bogs and wet habitats. In addition, *M. unifolia* has a densely flowered inflorescence with flowers that mature from the bottom up.

There are 5 taxa in the Fayette County flora that are listed by the Pennsylvania Department of Agriculture (2007) as noxious weeds: *Cirsium arvense* (Canadian Thistle), *Cirsium vulgare* (Bull or Spear Thistle), *Datura stramonium* (Jimsonweed), *Lythrum salicaria* (Purple Loosestrife), and *Rosa multiflora* (Multiflora Rose). Other species considered serious invasives in Pennsylvania's native ecosystems are: *Acer platanoides* (Norway Maple), *Acer pseudoplatanus* (Sycamore Maple), *Ailanthus altissima* (Tree-of-Heaven), *Alliaria petiolata* (Garlic Mustard), *Berberis thunbergii* (Japanese Barberry), *Celastrus orbiculatus* (Oriental Bittersweet), *Chelidonium majus* (Greater Celandine), *Conium maculatum* (Poison Hemlock), *Coronilla varia* (Crown Vetch), *Elaeagnus umbellata* (Autumn Olive), *Euonymus alatus* (Winged Euonymus), *Festuca elatior* (Tall Fescue), *Hesperis matronalis* (Dame's Rocket), *Ligustrum obtusifolium* (Border Privet), *Ligustrum vulgare* (Common Privet), *Lonicera japonica* (Japanese Honeysuckle), *Lonicera maackii* (Amur Honeysuckle), *Lonicera morrowii* (Morrow's Honeysuckle), *Microstegium vimineum* (Japanese Stilt Grass), *Ornithogalum umbellatum* (Star-of-Bethlehem), *Pastinaca sativa* (Wild Parsnip), *Phalaris arundinacea* (Reed Canary-grass), *Polygonum cuspidatum* (Japanese Knotweed), *Polygonum sachalinense* (Japanese Knotweed), *Potamogeton crispus* (Curly Pondweed), and *Spiraea japonica* (Japanese Spiraea) (DCNR 2004).

While this checklist probably does not include of every species in Fayette County, it is the most comprehensive list presently available.

ANNOTATED CHECKLIST OF THE SPECIES OF FAYETTE COUNTY, PENNSYLVANIA

Taxa are listed according to the following format: taxon name, author(s), {(year) collector and number} **global: state ranking** [Synonyms], non-native source and herbarium location if not CM. We follow the state (**S**) and global (**G**) ranking systems developed by The Nature Conservancy (1996). The global numbers are designated from **1** (critically imperiled) to **5** (secure). Other notations include **SH**, which denotes historical occurrence, and **SR**, which indicates reported without persuasive documentation. Synonyms are included for names not in common usage in the state or regional manuals. In cases where there was more than one specimen present in the collection, recent collections of current collectors for the western Pennsylvania region were cited.

Families, genera, and specific and infraspecific taxa are arranged alphabetically within vascular plant groups Angiosperms, Gymnosperms, Lycophytes, Equisetophytes, and Polypodiophytes.

ANGIOSPERMS

Acanthaceae

Justicia americana (L.) Vahl, 2006 L. Speedy LS-06-842

Aceraceae

Acer negundo L. var. *negundo*, 2006 L. Speedy LS-06-343
Acer nigrum Michx. f., 2007 L. Speedy and J. Nusser 07-605
Acer pensylvanicum L., 2006 L. Speedy LS-06-143
Acer platanoides L., 2007 L. Speedy 07-1631 Europe
Acer pseudoplatanus L., 1935 R. Chinn s.n. Europe
Acer saccharum Marsh. var. *saccharum*, 2006 L. Speedy LS-06-144
Acer saccharinum L., 2006 L. Speedy LS-06-106
Acer spicatum Lam., 1981 F.H. Utech 81-038
Acer rubrum L. var. *rubrum*, 2007 L. Speedy LS-07-20-1
Acer rubrum L. var. *trilobum* Torr. & Gray ex K. Koch, 1902 J.A. Shafer s.n.

Acoraceae

Acorus calamus L., 1977 M. Polechko s.n. India

Alismataceae

Alisma subcordatum Raf., 2006 L. Speedy LS-06-846
Sagittaria australis (J.G.Sm.) Small, 2006 L. Speedy and M. Bowers LS-06-805
Sagittaria graminea Michx. var. *graminea*, 2006 L. Speedy and D. Sofran LS-06-933
Sagittaria latifolia Willd., 1977 M. Polechko s.n.
Sagittaria rigida Pursh, 1977 M. Polechko s.n.

Amaranthaceae

Amaranthus hypochondriacus L., 1886 J.A. Shafer s.n. Africa

Anacardiaceae

Rhus copallinum L. var. *latifolia* Engl., 2007 L. Speedy 07-1029
Rhus glabra L., 1953 L.K. Henry and W.E. Buker s.n.
Rhus typhina L., 2006 L. Speedy LS-06-340
Toxicodendron radicans (L.) Kuntze ssp. *radicans*, 2007 L. Speedy 07-1853
Toxicodendron vernix (L.) Kuntze, 1922 E.H. McClelland s.n.

Annonaceae

Asimina triloba (L.) Dunal, 2006 L. Speedy LS-06-107

Apiaceae

Angelica atropurpurea L., 1948 W.E. Buker s.n.
Angelica triquinata Michx., 2006 L. Speedy and J. Nusser LS06-661-1
Angelica venenosa (Greenway) Fern., 2007 L. Speedy 07-1532
Cicuta maculata L., 2007 L. Speedy 07-1023
Chaerophyllum procumbens (L.) Crantz var. *procumbens,* 2006 L. Speedy LS-06-104
Conium maculatum L., 1901 J.A. Shafer s.n. Europe
Cryptotaenia canadensis (L.) DC., 1999 R.B. Coxe s.n.
Daucus carota L., 1981 F.H. Utech 81-214 Eurasia
Erigenia bulbosa (Michx.) Nutt., 2006 L. Speedy LS-06-43 **G5:S4**
Heracleum maximum Bartr., 2006 L. Speedy LS06-342-1
Hydrocotyle americana L., 2007 L. Speedy and M. Bowers 07-848
Osmorhiza claytonia (Michx.) C.B. Clarke, 2006 L. Speedy LS-06-171
Osmorhiza longistylis (Torr.) DC., 2006 L. Speedy LS-06-172
Oxypolis rigidior (L.) Raf., 2006 L. Speedy and M. Bowers LS-06-791 **G5:S2**
Pastinaca sativa L., 1981 F.H. Utech 81-212 Eurasia
Sanicula canadensis L. var. *canadensis,* 2007 L. Speedy and M. Bowers 07-688
Sanicula marilandica L., 2007 L. Speedy LS-07-257
Sanicula odorata (Raf.) K.M. Pryer & L.R. Phillippe, 2006 L. Speedy and D. Sofran LS-06-212
Sanicula trifoliata Bickn., 2007 L. Speedy 07-613
Sium suave Walt., 2007 L. Speedy 07-1031
Taenidia integerrima (L.) Drude, 2007 L. Speedy and M. Bowers 07-685
Thaspium barbinode (Michx.) Nutt., 2006 L. Speedy and D. Sofran LS-06-211
Thaspium trifoliatum (L.) Gray var. *aureum* Britt., 1959 W.E. Buker s.n.
Zizia aptera (Gray) Fern., 1959 W.E. Buker s.n.
Zizia aurea (L.) W.D.J. Koch, 2007 L. Speedy and M. Bowers LS-07-239

Apocynaceae

Amsonia tabernaemontana Walt. var. *tabernaemontana,* 1941 J. Lewis s.n.
Apocynum androsaemifolium L., 1941 O.E. Jennings s.n.
Apocynum cannabinum L., 2006 L. Speedy LS-06-363
Vinca minor L., 2007 L. Speedy 07-1723 Europe

Aquifoliaceae

Ilex laevigata (Pursh) Gray, 1933 J. Bright 8642
Ilex montana Torr. & Gray ex Gray, 2006 L. Speedy LS-06-405
Ilex verticillata (L.) Gray, 2007 L. Speedy 07-1615
Nemopanthus mucronatus (L.) Loes., 1946 O.E. Jennings s.n.

Araceae

Arisaema dracontium (L.) Schott, 1923 E.H. McClelland s.n.
Arisaema triphyllum (L.) Schott ssp. *pusillum* (Peck) Huttleston, 1905 O.E. Jennings s.n.
Arisaema triphyllum (L.) Schott ssp. *stewardsonii* (Britt.) Huttleston, 2006 L. Speedy LS-06-355
Arisaema triphyllum (L.) Schott ssp. *triphyllum,* 1995 B.L. Isaac and J.A. Isaac 7074
Orontium aquaticum L., 2006 L. Speedy LS-06-164 **G5:S4**
Peltandra virginica (L.) Schott, 1991 S.A. Thompson 8912
Symplocarpus foetidus (L.) Salisb. ex Nutt., 2007 L. Speedy LS-07-18

Araliaceae

Aralia nudicaulis L., 2006 L. Speedy LS-06-200
Aralia racemosa L. ssp. *racemosa,* 2006 L. Speedy and J. Nusser and M. Bowers LS-06-598
Aralia spinosa L., 2006 L. Speedy LS-06-832
Panax quinquefolium L., 2006 L. Speedy and J. Nusser and M. Bowers LS-06-595
Panax trifolius L., 2006 L. Speedy LS-06-141

Aristolochiaceae

Aristolochia macrophylla Lam., 1992 J.A. Isaac 3920
Aristolochia serpentaria L., 1905 J.A. Shaferand Kinzer, G.E. s.n.
Asarum canadense L., 2006 Speedy, L. LS-06-52

Asclepiadaceae

Asclepias exaltata L., 2007 L. Speedy and M. Bowers 07-692
*Asclepias incarnata*L. ssp. *incarnata,* 1981 F.H. Utech 81-126
Asclepias purpurascens L., 1999 R.B. Coxe s.n.
Asclepias quadrifolia Jacq., 1942 O.E. Jennings s.n.
Asclepias syriaca L., 2006 L. Speedy and Nusser, J. LS-06-581
Asclepias tuberosa L. ssp. *tuberosa,* 1981 F.H. Utech 81-047

Asteraceae

Achillea millefolium L. var. *millefolium,* 2007 L. Speedy LS-07-401 Europe
Ageratina altissima (L.) King & H.E. Robins. var. *altissima,* 2006 L. Speedy and D. Sofran LS-06-930
Ambrosia artemisiifolia L. var. *elatior* (L.) Descourtils, 2007 L. Speedy 07-1703
Ambrosia trifida L. var. *trifida,* 2006 L. Speedy LS-06-849
Anaphalis margaritacea (L.) Benth., 2007 L. Speedy 07-1829
Antennaria howellii Greene ssp. *neodioica* (Greene) Bayer, 2006 L. Speedy LS-06-110
Antennaria neglecta Greene, 2007 L. Speedy LS-07-364
Antennaria parlinii Fern. ssp. *fallax* (Greene) Bayer & Stebbins, 1950 L.K. Henry and F.H. Beer s.n.
Antennaria parlinii Fern. ssp. *parlinii,* 2007 L. Speedy LS-07-187
Antennaria plantaginifolia (L.) Richards., 1934 E.H. Graham s.n.
Antennaria solitaria Rydb., 1999 S.P. Grund 2141 **G5:S1**
Anthemis arvensis L., 1924 J. Bright s.n. Europe
Anthemis cotula L., 1901 J.A. Shafer s.n. Europe
Arctium minus Bernh., 1991 F.H. Utech 91-1341 Eurasia
Arctium tomentosum P. Mill., 1984 S.A. Thompson and J. Loughlin 1881 Eurasia
Arnoglossum atriplicifolium (L.) H.E. Robins., 2006 L. Speedy LS-06-1011
Arnoglossum muehlenbergii (Schultz-Bip.) H.E. Robins., 1996 S. Grund and J.L. Smith 1673

Artemisia annua L., 1916 J. Bright s.n. Eurasia
Artemisia vulgaris L. var. *vulgaris*, 2004 E. Zimmerman 292 Eurasia
Bellis perenis L., 1985 D. Krueger #25 Europe, CUP
Bidens aristosa (Michx.) Britt., 2000 R. Coxe s.n.
Bidens bipinnata L., 1970 W.E. Buker s.n.
Bidens cernua L., 2006 L. Speedy LS-06-965
Bidens frondosa L., 2007 L. Speedy and et al. 07-1606
Bidens tripartita L., 2006 L. Speedy LS-06-851
Bidens vulgata Greene, 1916 O.E. Jennings and G.K. Jennings s.n.
Brickellia eupatorioides (L.) Shinners var. *eupatorioides*, 1928 O.E. Jennings s.n.
Centaurea biebersteinii DC., 1981 F.H. Utech 81-428 Europe
Centaurea jacea L., 1999 S.P. Grund 2387 Europe
Centaurea nigra L., 1920 J. Bright s.n. Europe
Cichorium intybus L., 2006 L. Speedy LS-06-573 Europe
Cirsium altissimum (L.) Spreng., 1994 J.A. Isaac 6072
Cirsium arvense (L.) Scop., 1987 R.S. Mulvihill and V.J. Mosca 48 Eurasia
Cirsium muticum Michx., 2007 L. Speedy 07-1545
Cirsium pumilum (Nutt.) Spreng., 1947 O.E. Jennings s.n.
Cirsium vulgare (Savi) Ten., 1931 O.E. Jennings s.n. Eurasia
Conoclinium coelestinum (L.) DC., 2006 L. Speedy LS-06-978 **G5:S3**
Conyza canadensis (L.) Cronq. var. *canadensis*, 2007 L. Speedy 07-1812
Coreopsis lanceolata L., 1999 R.B. Coxe s.n.
Coreopsis tinctoria Nutt. var. *tinctoria*, 1942 O.E. Jennings s.n.
Coreopsis tripteris L., 2007 L. Speedy 07-1059
Crepis capillaris (L.) Wallr., 1987 A.W. Cusick 27120 Europe
Doellingeria infirma (Michx.) Greene, 1942 J. Bright 19041 [*Aster infirmus* Michx.]
Doellingeria umbellata (P. Mill.) Nees var. *umbellata*, 2006 L. Speedy LS-06-979
Erechtites hieraciifolia (L.) Raf. ex DC. var. *hieraciifolia*, 1970 L.K. Henry s.n.
Erigeron annuus (L.) Pers., 1999 R.B. Coxe s.n.
Erigeron philadelphicus L. var. *philadelphicus*, 1999 R.B. Coxe s.n.
Erigeron pulchellus Michx. var. *pulchellus*, 1939 O.E. Jennings s.n.
Erigeron strigosus Muhl. ex Willd. var. *strigosus*, 1999 R.B. Coxe s.n.
Eupatorium altissimum L., 2006 L. Speedy LS-06-833
Eupatorium perfoliatum L. var. *perfoliatum*, 2007 L. Speedy 07-1055
Eupatorium rotundifolium L. var. *ovatum* (Bigelow) Torr., 2006 L. Speedy LS-06-839 **G5:S3**
Eupatorium serotinum Michx., 2006 L. Speedy LS-06-850
Eupatorium sessilifolium L. var. *sessilifolium*, 1940 O.E. Jennings s.n.
Eutrochium fistulosum (Barratt) E. Lamont, 1981 F.H. Utech 81-433
Eutrochium maculatum (L.) E. Lamont var. *maculatum*, 2001 J. Polonoli FG89
Eutrochium purpureum (L.) E. Lamont var. *purpureum*, 2006 L. Speedy LS-06-1006
Eurybia divaricata (L.) Nesom, 2006 L. Speedy LS-06-945 [*Aster divaricata* L.]
Eurybia macrophylla (L.) Cass., 2006 L. Speedy LS-06-838 [*Aster macrophylla* L.]
Eurybia radula (Ait.) Nesom, 1961 D.H. Ross 34 **G5:S2** [*Aster radula* Ait.]
Eurybia schreberi (Nees) Nees, 2006 L. Speedy and J. Nusser LS-06-663 [*Aster schreberi* Nees]
Euthamia graminifolia (L.) Greene var. *graminifolia*, 2007 L. Speedy 07-1622
Galinsoga quadriradiata Cav., 2004 E. Zimmerman 291 Central and South America
Gamochaeta purpurea (L.) Cabrera, 1939 O.E. Jennings and G.K. Jennings s.n.
Gnaphalium uliginosum L., 1987 A.W. Cusick 27122 Europe
Hasteola suaveolens (L.) Pojark., 1903 O.P. Medsger s.n.
Helenium autumnale L. var. *autumnale*, 2007 L. Speedy 07-1735
Helianthus decapetalus L., 2006 L. Speedy and D. Sofran LS-06-726
Helianthus divaricatus L., 1951 L.K. Henry and W.E. Buker s.n.
Helianthus giganteus L., 1950 L.K. Henry and W.E. Buker s.n.
Helianthus hirsutus Raf., 2007 L. Speedy LS 07-1537 **G5:S2**
Helianthus microcephalus Torr. & Gray, 2006 L. Speedy LS-06-954 **G5:S3**
Helianthus strumosus L., 1951 L.K. Henry and W.E. Buker s.n.
Helianthus tuberosus L., 1957 L.K. Henry s.n.
Heliopsis helianthoides (L.) Sweet var. *helianthoides*, 2006 L. Speedy and D. Sofran LS-06-725
Hieracium caespitosum Dumort., 2007 L. Speedy LS-07-404 Europe
Hieracium gronovii L., 1961 W.E. Buker s.n.
Hieracium kalmii L. var. *fasciculatum* (Pursch) Lepage, 1942 O.E. Jennings s.n. **G5:S3**
Hieracium paniculatum L., 2006 L. Speedy and J. Nusser LS-06-673
Hieracium scabrum Michx. var. *scabrum*, 1966 W.E. Buker s.n.
Hieracium venosum L., 2006 L. Speedy LS-06-553
Hypochaeris radicata L., 2004 E.A. Zimmerman 222 Eurasia
Ionactis linariifolius (L.) Greene, 2001 J. Polonoli FG91
Krigia biflora (Walt.) Blake var. *biflora*, 1961 D.H. Ross 9
Lactuca biennis (Moench) Fern., 2007 L. Speedy 07-1702
Lactuca canadensis L., 1953 L.K. Henry and F.H. Beer s.n.
Lactuca floridana (L.) Gaertn. var. *floridana*, 2007 L. Speedy 07-1447
Lactuca hirsuta Muhl. ex Nutt. var. *sanguinea* (Bigelow) Fern., 1900 J.A. Shafer s.n. **G5?:S3**
Lapsana communis L., 1999 S.P. Grund 2353 Europe
Leucanthemum vulgare Lam., 2007 L. Speedy LS-07-409 Europe [*Chrysanthemum leucanthemum* L.]
Liatris scariosa (L.) Willd. var. *scariosa*,1917 B.H. Patterson s.n. **G5?:S2**
Marshallia grandiflora Beadle. & F.E. Boynt., 2001 J. Polonoli FG92 **G2:S1**
Oclemena acuminata (Michx.) Greene, 1987 A.W. Cusick 26997 [*Aster acuminata* Michx.]
Packera aurea (L.) A. & D. Love, 2006 L. Speedy LS-06-155 [*Senecio aureus* L.]

Packera obovata (Muhl. ex Willd.) W.A. Weber & A. Love, 2006 L. Speedy LS-06-184 [*Senecio obovatus* Muhl.ex Willd.]
Packera paupercula (Michx.) A. & D. Love, 1915 B.H. Patterson s.n. [*Senecio paupercula* Michx.]
Prenanthes alba L., 1916 J. Bright s.n.
Prenanthes altissima L., 2006 L. Speedy LS-06-981
Prenanthes crepidinea Michx., 2007 L. Speedy LS-07-121
Prenanthes trifoliolata (Cass.) Fern., 1947 W.E. Buker s.n.
Pseudognaphalium macounii (Greene) Kartesz, 1933 L. Lincoln s.n. [*Gnaphalium macounii* Greene]
Pseudognaphalium obtusifolium (L.) Hilliard & Burtt ssp. *obtusifolium*, 1956 W.E. Buker s.n. [*Gnaphalium obtusifolium* L.]
Rudbeckia hirta L. var. *hirta*, 1965 H.H. Fong and F.H. Pettler and W.M. Fylypiw WP-1143
Rudbeckia hirta L. var. *pulcherrima* Farw., 1999 R.B. Coxe s.n.
Rudbeckia laciniata L. var. *laciniata*, 1999 R.B. Coxe s.n.
Rudbeckia triloba L. var. *triloba*, 1950 L.K. Henry and W.E. Buker s.n.
Sericocarpus asteroides (L.) B.S.P., 1923 J. Bright s.n.
Silphium perfoliatum L. var. *perfoliatum*, 1941 O.E. Jennings s.n.
Silphium trifoliatum L. var. *trifoliatum*, 1934 J.F. Lewis 518
Smallanthus uvedalius (L.) Mackenzie ex Small, 2007 L. Speedy 07-1446-1 **G4G5:SR**[*Polymnia uvedalius* (L.) L.]
Solidago altissima L., 2006 L. Speedy LS-06-948
Solidago arguta Ait. var. *arguta*, 1987 A.W. Cusick 26995
Solidago bicolor L., 2006 L. Speedy LS-06-830
Solidago caesia L., 2007 L. Speedy 07-1653
Solidago canadensis L. var. *canadensis*, 1981 F.H. Utech 81-496
Solidago canadensis L. var. *hargeri* Fern.,1910 O.E. Jennings and G.K. Jennings s.n.
Solidago erecta Pursh, 1901 J.A. Shafer s.n.
Solidago flexicaulis L., 2007 L. Speedy 07-1577
Solidago gigantea Ait., 1942 O.E. Jennings s.n.
Solidago juncea Ait., 1965 L.K. Henry s.n.
Solidago nemoralis Ait. var. *nemoralis*, 2006 L. Speedy LS-06-957
Solidago patula Muhl. ex Willd. var. *patula*, 2007 L. Speedy 07-1657
Solidago rugosa P. Mill. ssp. *aspera*, (Ait.) Cronq., 1950 L.K. Henry and W.E. Buker s.n.
Solidago rugosa P. Mill. ssp. *rugosa* var. *rugosa*, 1987 A.W. Cusick 26919
Solidago rugosa P. Mill. ssp. *rugosa* var. *sphagnophila* Graves, 1945 O.E. Jennings s.n.
Solidago speciosa Nutt. var. *speciosa*, 1915 J. Bright s.n. **G5T5?:SNR**
Solidago squarrosa Nutt., 1929 O.E. Jennings s.n.
Solidago uliginosa Nutt. var. *linoides* (Torr. & Gray), 1984 S.A. Thompson and J.M. Loughlin 1889 **G4G5:S3**
Solidago uliginosa Nutt. var. *uliginosa*, 2006 L. Speedy and Botanical Society of Western PA LS-06-1041 **G4G5:S3**
Solidago ulmifolia Muhl. ex Willd. var. *ulmifolia*, 1945 O.E. Jennings s.n.
Sonchus asper (L.) Hill, 1924 J. Bright s.n. Europe
Symphyotrichum cordifolium (L.) Nesom, 2006 L. Speedy LS-06-946 [*Aster cordifolius* L.]
Symphyotrichum lanceolatum (Willd.) Nesom ssp. *lanceolatum* var. *lanceolatum*, 2007 L. Speedy and et al. 07-1603 [*Aster lanceolatus* Willd.]
Symphyotrichum lateriflorum (L.) A. & D. Love var. *lateriflorum*, 2007 L. Speedy 07-1713 [*Aster lateriflorus* (L.) Britton]
Symphyotrichum lowrieanum (Porter) Nesom, 1956 W.E. Buker s.n. [*Aster lowrieanum* Porter]
Symphyotrichum novae-angliae (L.) Nesom, 2006 L. Speedy LS-06-1015 [*Aster novae-angliae* L.]
Symphyotrichum patens (Ait.) Nesom var. *patens*, 1970 L.K. Henry s.n. [*Aster patens* Ait.]
Symphyotrichum phlogifolium (Muhl. ex Willd.) Nesom, 1938 O.E. Jennings s.n. [*Aster phlogifoliuim* Muhl. ex Willd.]
Symphyotrichum pilosum (Willd.) Nesom var. *pilosum*, 2006 L. Speedy LS-06-1016 [*Aster pilosus* Willd.]
Symphyotrichum pilosum (Willd.) Nesom var. *pringlei* (Gray) Nesom, 1956 W.E. Buker s.n. [*Aster pilosus* Willd. var. pringlei (A. Gray) S.F. Blake]
Symphyotrichum praealtum (Poir.) Nesom var. *angustior* (Wieg.) Nesom, 1950 L.K. Henry and W.E. Buker s.n. **G5:S3** [*Aster praealtum* Poir. var. *angustior* Wieg.]
Symphyotrichum prenanthoides (Muhl. ex Willd.) Nesom, 2006 L. Speedy LS-06-955 [*Aster prenanthoides* Muhl. ex Willd.]
Symphyotrichum puniceum (L.) A. & D. Love var. *puniceum*, 2006 L. Speedy LS-06-960 [*Aster puniceus* L.]
Symphyotrichum shortii (Lindl.) Nesom, 2007 L. Speedy 07-1629 [*Aster shortii* Lindl.]
Symphyotrichum undulatum (L.) Nesom, 1981 F.H. Utech 81-473 [*Aster undulatum* L.]
Taraxacum laevigatum (Willd.) DC., 1905 O.E. Jennings s.n. Eurasia
Taraxacum officinale G.H. Weber ex Wiggers ssp. *officinale*, 1953 L.K. Henry and W.E. Buker s.n. Eurasia
Tussilago farfara L., 1959 W.E. Buker s.n. Eurasia
Verbesina alternifolia (L.) Britt. ex Kearney, 2007 L. Speedy 07-1643
Vernonia gigantea (Walt.) Trel. ssp. *gigantea*, 1987 A.W. Cusick 26912
Vernonia noveboracensis (L.) Michx., 2000 R.B. Coxe s.n.
Xanthium strumarium L. var. *canadense* (P. Mill.) Torr. & Gray, 1969 W.E. Buker s.n.

Balsaminaceae

Impatiens capensis Meerb., 2007 L. Speedy and J. Nusser 07-603
Impatiens pallida Nutt., 2007 L. Speedy 07-1065

Berberidaceae

Berberis thunbergii DC., 2006 L. Speedy LS-06-344 Japan
Caulophyllum thalictroides (L.) Michx., 2006 L. Speedy LS-06-38
Jeffersonia diphylla (L.) Pers., 1950 L.K. Henry and F.H. Beer s.n.
Podophyllum peltatum L., 2006 L. Speedy and D. Sofran LS-06-221

Betulaceae

Alnus incana (L.) Moench ssp. *rugosa* (Du Roi) Clausen, 2007 L. Speedy 07-1038

Alnus serrulata (Ait.) Willd., 2006 L. Speedy LS-06-162
Betula alleghaniensis Britt. var. *alleghaniensis,* 2006 L. Speedy LS-06-1013
Betula alleghaniensis Britt. var. *macrolepis* (Fern.) Brayshaw, 1934 O.E. Jennings s.n.
Betula lenta L., 2007 L. Speedy 07-1731
Carpinus caroliniana Walt. ssp. *virginiana* (Marsh.) Furlow, 2006 L. Speedy LS-06-969
Corylus americana Walt., 2006 L. Speedy LS-06-440
Ostrya virginiana (P. Mill.) K. Koch var. *virginiana,* 2006 L. Speedy LS-06-32

Bignoniaceae

Campsis radicans (L.) Seem. ex Bureau, 1901 J.A. Shafer s.n.
Catalpa bignonioides Walt., 1940 J.F. Lewis s.n.
Catalpa speciosa (Warder) Warder ex Engelm., 2007 L. Speedy 07-1647

Boraginaceae

Cynoglossum officinale L., 2004 E.A. Zimmerman 212 Eurasia
Cynoglossum virginianum L. var. *virginianum,* 1961 L.K. Henry s.n.
Echium vulgare L. var. *vulgare,* 1999 R.B. Coxe s.n. Europe
Hackelia virginiana (L.) I.M. Johnston, 2007 L. Speedy 07-1454
Heliotropium europaeum L., 1972 A.W. Cusick 12647 Europe
Lappula squarrosa (Retz.) Dumort., 1924 J. Bright s.n. Eurasia
Lithospermum latifolium Michx., 2006 L. Speedy LS-06-624 **G4:S4**
Mertensia virginica (L.) Pers. ex Link, 1950 L.K. Henry and F.H. Beer s.n.
Myosotis laxa Lehm., 1999 R.B. Coxe s.n.
Myosotis scorpioides L., 2007 L. Speedy 07-1019 Europe
Onosmodium molle Michx. ssp. *hispidissimum* (Mackenzie) Boivin, 1901 J.A. Shafer 172 **G4G5T4:S1**

Brassicaceae

Alliaria petiolata (Bieb.) Cavara & Grande, 2006 L. Speedy LS-06-133 Europe
Arabis canadensis L., 2004 R. Coxe s.n.
Arabis glabra (L.) Bernh., 1923 O.E. Jennings and E.H. Graham s.n.
Arabis laevigata (Muhl. ex Willd.) Poir. var. *laevigata,* 2006 L. Speedy LS-06-103
Barbarea vulgaris Ait. f., 1987 F.H. Utech 87-128 Eurasia
Brassica juncea (L.) Czern., 1924 J. Bright s.n. Eurasia
Brassica nigra (L.) W.D.J. Koch, 1901 J.A. Shafer s.n. Eurasia
Brassica rapa L. var. *rapa,* 1929 J. Bright 2561 Europe
Capsella bursa-pastoris (L.) Medik, 1950 L.K. Henry and F.H. Beer s.n. Eurasia
Cardamine angustata O.E. Shulz, 2007 L. Speedy LS-07-103
Cardamine bulbosa (Schreb. ex Muhl.) B.S.P., 2007 L. Speedy LS-07-182
Cardamine concatenata (Michx.) Sw., 2006 L. Speedy LS-06-12
Cardamine diphylla (Michx.) Wood, 2006 L. Speedy LS-06-137
Cardamine flexuosa With., 1975 W.E. Buker s.n. Europe
Cardamine parviflora L. var. *arenicola* (Britt.) O.E. Schulz, 1924 J. Bright s.n.
Cardamine pensylvanica Muhl. ex Willd., 2006 L. Speedy LS-06-152
Cardamine rotundifolia Michx., 2007 L. Speedy and M. Bowers LS-07-228
Draba verna L., 1951 W.E. Buker s.n. Europe
Erysimum cheiranthoides L., 1904 O.E. Jennings s.n. Eurasia
Hesperis matronalis L., 2006 L. Speedy and D. Sofran LS-06-226 Europe
Lepidium campestre (L.) Ait. f., 1999 R.B. Coxe s.n. Eurasia
Lepidium virginicum L. var. *virginicum,* 1939 W.G. Burig s.n.
Raphanus raphanistrum L. var. *raphanistrum,* 1942 O.E. Jennings s.n. Mediterranean
Raphanus sativus L., 1948 W.E. Buker s.n. Mediterranean
Rorippa nasturtium-aquaticum (L.) Hayek, 2006 L. Speedy LS-06-134
Rorippa palustris (L.) Bess. ssp. *fernaldiana* (Butters & Abbe) Jonsell, 1905 J.A. Shafer and G.E. Kinzer s.n.
Rorippa sylvestris (L.) Bess., 1987 A.W. Cusick 27121 Europe
Sinapis alba L., 1948 W.E. Buker s.n. Mediterranean
Sinapis arvensis L., 1902 J.A. Shafer s.n. Mediterranean
Sisymbrium altissimum L., 1923 O.E. Jennings and E.H. Graham s.n. Eurasia
Thlaspi arvense L., 1975 W.E. Buker s.n. Europe

Callitrichaceae

Callitriche heterophylla Pursh ssp. *heterophylla,* 1950 W.E. Buker s.n.
Callitriche palustris L., 1989 C. Bier and T. Bier s.n.
Callitriche terrestris Raf., 1939 O.E. Jennings s.n.

Calycanthaceae

Calycanthus floridus L. var. *floridus,* 1939 O.E. Jennings s.n.

Campanulaceae

Campanula aparinoides Pursh, 1948 D.H. Krouse s.n.
Campanulastrum americanum (L.) Small, 2007 L. Speedy 07-1669
Lobelia cardinalis L., 2006 L. Speedy and D. Sofran LS-06-728
Lobelia inflata L., 2007 L. Speedy 07-1733
Lobelia siphilitica L. var. *siphilitica,* 2006 L. Speedy and D. Sofran LS-06-929
Lobelia spicata Lam. var. *spicata,* 1965 L.K. Henry s.n.
Triodanis perfoliata (L.) Nieuwl. var. *perfoliata,* 1935 C.M. Boardman s.n.

Cannabaceae

Humulus japonicus Sieb. & Zucc., 1991 F.H. Utech 91-2024 Asia
Humulus lupulus L. var. *lupuloides* E. Small, 2006 L. Speedy LS-06-852

Caprifoliaceae

Diervilla lonicera P. Mill., 1902 J.A. Shafer and O.P. Medsger s.n.
Lonicera canadensis Bartr. ex Marsh., 1932 W.R. VanDersal s.n.
Lonicera dioica L., 1932 W.R. VanDersal s.n.
Lonicera japonica Thunb., 2007 L. Speedy 07-1805 Asia
Lonicera maackii (Rupr.) Herder, 1999 R.B. Coxe s.n. Asia
Lonicera morrowii Gray, 2007 L. Speedy 07-1650 Japan
Sambucus nigra L. ssp. *canadensis* (L.) R. Bolli, 2006 Speedy, L. LS-06-341

Sambucus racemosa L. var. *racemosa,* 2006 Speedy, L. LS06-146-2
Symphoricarpos albus (L.) Blake var. *laevigatus* (Fern.) Blake, 1956 W.E. Buker s.n.
Triosteum aurantiacum Bickn. var. *aurantiacum,* 1921 E.H. McClelland s.n.
Triosteum aurantiacum Bickn. var. *glaucescens* Wieg., 1929 O.E. Jennings s.n.
Viburnum acerifolium L., 2007 L. Speedy 07-1061
Viburnum dentatum L. var. *dentatum,* 1999 R.B. Coxe s.n.
Viburnum lentago L., 1946 O.E. Jennings s.n.
Viburnum nudum L. var. *cassinoides* (L.) Torr. & Gray, 2006 L. Speedy and T. Pearson and D. Bryant LS-06-761 **G5:S1**
Viburnum prunifolium L., 2006 L. Speedy LS-06-197
Viburnum recognitum Fern., 2006 L. Speedy LS-06-434

Caryophyllaceae

Agrostemma githago L., 1984 F.H. Utech 84-377 Europe
Arenaria serpyllifolia L., 1999 R.B. Coxe s.n. Europe
Cerastium fontanum Baumg. ssp. *vulgare* (Hartman) Greuter & Burdet, 1923 E.H. McClelland s.n. Eurasia
Cerastium glomeratum Thuill., 1939 O.E. Jennings s.n. Eurasia
Cerastium nutans Raf. var. *nutans,* 1957 L.K. Henry s.n.
Dianthus armeria L., 2007 L. Speedy LS-07-408 Europe
Dianthus barbatus L., 1999 R.B. Coxe s.n. Eurasia
Moehringia lateriflora (L.) Fenzl, 1946 H.N. Mozingo s.n.
Myosoton aquaticum (L.) Moench, 1997 S.P. Grund 1787 Europe
Paronychia canadensis (L.) Wood, 2006 L. Speedy LS-06-565
Paronychia fastigiata (Raf.) Fern. var. *fastigiata,* 1939 W.G. Burig s.n.
Saponaria officinalis L., 2007 L. Speedy 07-1707 Europe
Silene antirrhina L., 1930 W.R. VanDersal 1671
Silene latifolia Poir., 2006 L. Speedy and K. Jurkovic LS-06-468 Europe
Silene nivea (Nutt.) Muhl. ex Otth, 1905 B.C. Van Pitt No. 145, PH
Silene stellata (L.) Ait. f., 2006 L. Speedy LS-06-564
Silene vulgaris (Moench) Garcke, 1952 C.M. Boardman s.n. Europe
Spergula arvensis L., 1905 J.A. Shafer s.n. Eurasia
Stellaria graminea L., 1946 O.E. Jennings s.n. Europe
Stellaria longifolia Muhl. ex Willd. var. *longifolia,* 2007 L. Speedy and M. Bowers LS-07-240
Stellaria media (L.) Vill. ssp. *media,* 2007 L. Speedy LS-07-93 Europe
Stellaria pubera Michx., 2006 L. Speedy LS-06-111

Celastraceae

Celastrus orbiculata Thunb., 2006 L. Speedy LS-06-950 Japan and China
Celastrus scandens L., 1999 R.B. Coxe s.n.
Euonymus alatus (Thunb.) Sieb., 2007 L. Speedy 07-1652 China and Japan
Euonymus americanus L., 1964 W.E. Buker s.n.
Euonymus atropurpurea Jacq. var. *atropurpurea,* 1935 J.F. Lewis s.n.
Euonymus obovatus Nutt., 1946 H.N. Mozingo s.n.

Chenopodiaceae

Chenopodium album L. var. *missouriense* (Aellen) I.J. Bassett & C.W. Crompton, 1950 L.K. Henry and W.E. Buker s.n.
Chenopodium botrys L., 1902 J.A. Shafer s.n. Europe
Chenopodium simplex (Torr.) Raf., 1940 O.E. Jennings s.n.

Cistaceae

Lechea racemulosa Michx., 2006 L. Speedy LS-06-560

Clethraceae

Clethra acuminata Michx., 2006 L. Speedy LS-06-633 **G4:S1**

Clusiaceae

Hypericum ascyron L., 1919 O.E. Jennings and G.K. Jennings s.n.
Hypericum canadense L., 2006 L. Speedy and K. Jurkovic LS-06-680
Hypericum densiflorum Pursh, 2007 L. Speedy 07-1541 **G5:S3**
Hypericum ellipticum Hook., 2007 L. Speedy and M. Bowers 07-841
Hypericum gentianoides (L.) B.S.P., 2007 L. Speedy and Botanical Society of Western PA 07-1553
Hypericum hypericoides (L.) Crantz ssp. *multicaule* (Michx. ex Willd.) Robson, 1915 J. Bright s.n.
Hypericum mutilum L., 2006 L. Speedy and K. Jurkovic LS-06-681
Hypericum perforatum L., 1999 R.B. Coxe s.n. Europe
Hypericum prolificum L., 2007 L. Speedy and M. Bowers 07-691
Hypericum punctatum Lam., 1965 L.K. Henry s.n.
Triadenum fraseri (Spach) Gleason, 2006 L. Speedy and K. Jurkovic LS-06-687
Triadenum virginicum (L.) Raf., 1984 S.A. Thompson and J. Loughlin 1888

Commelinaceae

Commelina communis L. var. *communis,* 2000 R. Coxe s.n. Asia
Tradescantia virginiana L., 1985 D. Krueger 166-B, CUP

Convolvulaceae

Calystegia sepium (L.) R. Br. ssp. *appalachiana* Brummitt, 1981 F.H. Utech 81-222
Calystegia silvatica (Kit.) Griseb. ssp. *fraterniflora* (Mackenzie & Bush) Brummitt, 1950 L.K. Henry and W.E. Buker s.n.
Convolvulus arvensis L., 1948 L.K. Henry s.n. Europe
Ipomoea pandurata (L.) G.F.W. Mey., 1950 W.E. Buker s.n.

Cornaceae

Cornus alternifolia L. f., 1946 H.N. Mozingo s.n.
Cornus amomum P. Mill., 2006 L. Speedy LS-06-1018
Cornus florida L., 2006 L. Speedy LS-06-65
Cornus obliqua Raf., 2007 L. Speedy 07-1700
Cornus racemosa Lam., 1999 R.B. Coxe s.n.
Nyssa sylvatica Marsh., 2006 L. Speedy and M. Bowers LS-06-277

Crassulaceae

Hylotelephium telephium (L.) H. Ohba. ssp. *telephium,* 1999 R.B. Coxe s.n. Eurasia [*Sedum telephium* L.]

Penthorum sedoides L., 2005 B.C. Van Pitt No. 99, PH
Sedum ternatum Michx., 2007 L. Speedy LS-07-416

Cucurbitaceae
Echinocystis lobata (Michx.) Torr. & Gray, 2007 L. Speedy 07-1460
Sicyos angulatus L., 2006 L. Speedy LS-06-947

Cuscutaceae
Cuscuta gronovii Willd. ex J.A. Shultes var. *gronovii,* 1999 S.P. Grund and et al. 2348
Cuscuta pentagona Engeim. var. *pentagona,* 1982 F.H. Utech 82-389 **G5:S3**

Cyperaceae
Bulbostylis capillaris (L.) Kunth ex C.B. Clarke ssp. *capillaries,* 1972 A.W. Cusick 12649
Carex albicans Willd ex. Spreng var. *albicans,* 1960 W.E. Buker s.n.
Carex albolutescens Schwein., 1924 J. Bright s.n.
Carex albursina Sheldon, 2006 L. Speedy LS-06-563
Carex amphibola Steud., 1918 J. Bright s.n.
Carex annectens (Bickn.) Bickn., 1946 O.E. Jennings s.n.
Carex argyrantha Tuckerman, 1954 W.E. Buker s.n.
Carex atlantica Bailey ssp. *atlantica,* 2007 L. Speedy 07-538
Carex baileyi Britt., 1930 W.R. VanDersal 1661
Carex bromoides Schkuhr ex Willd. ssp. *bromoides,* 1999 R.B. Coxe s.n.
Carex careyana Torr. ex Dewey, 1997 S.P. Grund 1971 **G4G5:S1**
Carex cephaloidea (Dewey) Dewey, 1924 J. Bright s.n.
Carex cephalophora Muhl. ex Willd., 1908 O.E. Jennings s.n.
Carex communis Bailey var. *communis,* 2006 L. Speedy and K. Jurkovic LS-06-475
Carex crinita Lam. var. *crinita,* 1908 B.H. Patterson s.n.
Carex debilis Michx. var. *rudgei* Bailey, 2007 L. Speedy 07-545
Carex digitalis Willd. var. *digitalis,* 2006 L. Speedy and J. Nusser LS-06-676
Carex echinata Murr. ssp. *echinata,* 1951 W.E. Buker s.n.
Carex folliculata L., 2006 L. Speedy and K. Jurkovic LS-06-695
Carex frankii Kunth, 1999 R.B. Coxe s.n.
Carex glaucodea Tuckerman ex Olney, 1889 J.A. Shafer s.n.
Carex gracilescens Steud., 2006 L. Speedy LS-06-620
Carex gracillima Schwein., 1905 O.E. Jennings s.n.
Carex granularis Muhl. ex Willd., 1918 J. Bright s.n.
Carex grayi Carey, 1932 J. Bright 5453
Carex gynandra Schwein., 2007 L. Speedy and M. Bowers 07-941
Carex hirsutella Mackenzie, 2003 L. Speedy and C.M. Bowers s.n.
Carex hirtifolia Mackenzie, 1921 J. Bright s.n.
Carex hitchcockiana Dewey, 2006 L. Speedy LS-06-627
Carex interior Bailey, 2007 L. Speedy 07-531
Carex intumescens Rudge, 2007 L. Speedy 07-1720
Carex jamesii Schwein., 2007 L. Speedy LS-07-388
Carex laevivaginata (Kukenth.) Mackenzie, 2006 L. Speedy LS-06-410
Carex laxiculmis Schwein. var. *copulata* (Bailey) Fern., 1929 E.M. Gress s.n.
Carex laxiculmis Schwein. var. *laxiculmis,* 1920 O.E. Jennings s.n.
Carex laxiflora Lam. var. *laxiflora,* 1992 J.A. Isaac 3907
Carex leavenworthii Dewey, 1940 O.E. Jennings and J.F. Lewis s.n.
Carex leptalea Wahlenb. ssp. *leptalea,* 2006 L. Speedy LS-06-407
Carex leptonervia (Fern.) Fern., 2006 L. Speedy LS-06-406
Carex lupulina Muhl. ex Willd., 2007 L. Speedy 07-1538
Carex lurida Wahlenb., 2006 L. Speedy LS-06-416
Carex pensylvanica Lam., 2006 L. Speedy LS-06-14
Carex planispicata Naczi, 1929 J. Bright 1892
Carex plantaginea Lam., 2007 L. Speedy 07-609
Carex platyphylla Carey, 2006 L. Speedy LS-06-59
Carex prasina Wahlenb., 2006 L. Speedy LS-06-359
Carex projecta Mackenzie, 1999 Grund, S.P. 2262
Carex radiata (Wahlenb.) Small, 2006 L. Speedy LS-06-561
Carex roanensis F.J. Herm., 1929 J. Bright 1840
Carex rosea Schkuhr ex Willd., 1992 J.A. Isaac 3902
Carex scabrata Schwein., 2006 L. Speedy LS-06-408
Carex scoparia Schkuhr ex Willd. var. *scoparia,* 2007 L. Speedy and M. Bowers 07-938
Carex sparganioides Muhl. ex Willd. var. *sparganioides,* 1992 J.A. Isaac 3892
Carex stipata Muhl. ex Willd. var. *stipata,* 2006 L. Speedy LS-06-433
Carex striatula Michx., 2007 L. Speedy 07-616
Carex stricta Lam., 2007 L. Speedy and M. Bowers 07-832
Carex swanii (Fern.) Mackenzie, 2006 L. Speedy and M. Bowers LS-06-793
Carex torta Boott ex Tuckerman, 2006 L. Speedy LS-06-156
Carex tribuloides Wahlenb. var. *tribuloides,* 2007 L. Speedy and M. Bowers 07-838
Carex umbellata Schkuhr ex Willd., 1935 L.K. Henry s.n.
Carex virescens Muhl. ex Willd., 2007 L. Speedy 07-1074
Carex vulpinoidea Michx. var. *vulpinoidea,* 2003 L. Speedy and C.M. Bowers s.n.
Carex willdenowii Schkuhr ex Willd., 1923 J. Bright s.n.
Carex woodii Dewey, 1999 S.P. Grund 2260
Cyperus bipartitus Torr., 2006 L. Speedy LS-06-845
Cyperus esculentus L. var. *leptostachyus* Boeckl., 2006 L. Speedy LS-06-966
Cyperus flavescens L., 1997 S.P. Grund 2005
Cyperus odoratus L., 1997 Grund, S.P. 2020
Cyperus squarrosus L., 2006 L. Speedy LS-06-848
Cyperus strigosus L. 1999 R.B. Coxe s.n.
Dulichium arundinaceum (L.) Britt., 2006 L. Speedy and T. Pearson and D. Bryant LS-06-776
Eleocharis acicularis (L.) Roemer & J.A. Schultes, 1934 E.H. Graham s.n.
Eleocharis elliptica Kunth, 1999 S.P. Grund and et al. 2275
Eleocharis engelmannii Steud., 1999 S.P. Grund and R. Coxe and E. Copeland 2359
Eleocharis erythropoda Steud., 1949 O.E. Jennings s.n.
Eleocharis obtusa (Willd.) J.A. Schultes, 2006 L. Speedy LS-06-446
Eleocharis palustris (L.) Roemer & J.A. Schultes, 1986 C. Bier and B. Woodworth and M. Bowers s.n.

Eleocharis tenuis (Willd.) J.A. Schultes var. *pseudoptera* (Weatherby ex Svens.) Svens., 1940 O.E. Jennings s.n.

Eleocharis tenuis (Willd.) J.A. Schultes var. *tenuis,* 1999 R.B. Coxe s.n.

Eleocharis tenuis (Willd.) J.A. Schultes var. *verrucosa* (Svens.) Svens., 2007 L. Speedy 07-540 **G5T3T5:S1**

Eriophorum virginicum L., 2006 L. Speedy and Botanical Society of Western PA LS-06-1040

Fimbristylis autumnalis (L.) Roemer & J.A. Schultes, 1997 S.P. Grund 2008

Rhynchospora alba (L.) Vahl, 2006 L. Speedy and K. Jurkovic LS-06-698

Rhynchospora capitellata (Michx.) Vahl, 2006 L. Speedy and K. Jurkovic LS-06-685

Rhynchospora recognita (Gale) Kral, comb. nov. ined., 1974 R. Fulton s.n. **G5?:S1**

Schoenoplectus acutus (Muhl. Ex Bigelow) A. & D. Love var. *acutus,* 1949 W.E. Buker s.n. **G5:S2**

Schoenoplectus pungens (Vahl) Palla var. *pungens,* 1999 S.P. Grund and et al. 2333

Schoenoplectus purshianus (Fern.) M.T. Strong, 2006 L. Speedy and K. Jurkovic LS-06-688

Schoenoplectus tabernaemontani (K.C. Gmel.) Palla, 1977 M. Polechko s.n.

Scirpus atrovirens Willd., 1999 R.B. Coxe s.n.

Scirpus cyperinus (L.) Kunth, 2007 L. Speedy and M. Bowers 07-939

Scirpus expansus Fern., 2007 L. Speedy and M. Bowers 07-940

Scirpus hattorianus Makino, 1999 R.B. Coxe s.n.

Scirpus microcarpus J. & K. Presl, 1929 O.E. Jennings s.n.

Scirpus pendulus Muhl., 1952 O.E. Jennings s.n.

Scirpus polyphyllus Vahl, 2006 L. Speedyand K. Jurkovic LS-06-710

Dioscoreaceae

Dioscorea oppositifolia L., 2007 L. Speedy and et al. 07-1601 China

Dioscorea quaternata J.F. Gmel., 2006 L. Speedy LS-06-400

Dioscorea villosa L., 1999 R.B. Coxe s.n.

Dipsacaceae

Dipsacus fullonum L., 1991 S.A. Thompson 8905 Europe

Droseraceae

Drosera filiformis Raf., 2006 L. Speedy and T. Pearson and D. Bryant LS-06-782

Drosera rotundifolia L. var. *rotundifolia,* 2006 L. Speedy and K. Jurkovic LS-06-705

Elaeagnaceae

Elaeagnus umbellata Thunb., 2006 L. Speedy LS-06-117 Asia

Ericaceae

Epigaea repens L., 2006 L. Speedy and M. Bowers LS-06-271

Gaultheria procumbens L., 2006 L. Speedy LS-06-637

Gaylussacia baccata (Wangenh.) K. Koch, 2006 L. Speedy and E. Richards LS-06-295

Kalmia latifolia L., 2006 L. Speedy LS-06-415

Lyonia ligustrina (L.) DC. var. *ligustrina,* 2007 L. Speedy and M. Bowers 07-833

Oxydendrum arboreum (L.) DC., 2000 R. Coxe s.n. **G5:S3S4**

Rhododendron arborescens (Pursh) Torr., 2007 L. Speedy 07-539

Rhododendron maximum L., 2006 L. Speedy and M. Bowers LS-06-517

Rhododendron periclymenoides (Michx.) Shinners, 2006 L. Speedy and M. Bowers LS-06-280

Rhododendron viscosum (L.) Torr., 2006 L. Speedy and E. Richards LS-06-300

Vaccinium angustifolium Ait., 1995 B.L. Isaac and J.A. Isaac 7544

Vaccinium corymbosum L., 2006 L. Speedy LS-06-205

Vaccinium macrocarpon Ait., 2006 L. Speedy and K. Jurkovic LS-06-696

Vaccinium oxycoccos L., 2006 L. Speedy and E. Richards LS-06-298

Vaccinium pallidum Ait., 2006 L. Speedy LS-06-206

Vaccinium stamineum L., 2006 L. Speedy and M. Bowers LS-06-272

Euphorbiaceae

Acalypha rhomboidea Raf., 2007 L. Speedy 07-1575

Acalypha virginica L., 1902 J.A. Shafer and O.P. Medsger s.n.

Chamaesyce maculata (L.) Small, 1999 S.P. Grund and et al. 2349

Chamaesyce nutans (Lag.) Small, 1970 L.K. Henry s.n.

Euphorbia corollata L., 2007 L. Speedy and M. Bowers 07-683

Euphorbia cyparissias L., 1915 J. Bright s.n. Eurasia

Euphorbia dentata Michx. var. *dentata,* 2006 L. Speedy LS-06-952

Euphorbia lathyris L., 1934 E.B. Burgess s.n. Europe

Euphorbia marginata Pursch, 1941 O.E. Jennings s.n.

Fabaceae

Amorpha fruticosa L., 2000 R. Coxe s.n.

Amphicarpaea bracteata (L.) Fern. var. *bracteata,* 2007 L. Speedy 07-1576

Amphicarpaea bracteata (L.) Fern. var. *comosa* (L.) Fern., 1950 L.K. Henry and W.E. Buker s.n.

Apios americana Medik., 2006 L. Speedy and BSWP LS-06-755

Astragalus canadensis L. var. *canadensis,* 1942 O.E. Jennings s.n. **G5:S2**

Baptisia australis (L.) R. Br. ex Ait. f. var. *australis,* 2007 L. Speedy 07-1610 **G5:S3**

Baptisia tinctoria (L.) R. Br. ex Ait. f., 2007 L. Speedy and M. Bowers 07-666

Cercis canadensis L. var. *canadensis,* 2006 L. Speedy LS-06-97

Chamaecrista nictitans (L.) Moench ssp. *nictitans* var. *nictitans,* 2006 L. Speedy LS-06-834

Coronilla varia L., 2007 L. Speedy 07-627 Europe

Desmodium canadense (L.) DC., 1948 L.K. Henry s.n.

Desmodium canescens (L.) DC., 2007 L. Speedy 07-1026

Desmodium glutinosum (Muhl. ex Willd.) Wood, 1950 W.E. Buker s.n.

Desmodium laevigatum (Nutt.) D.C., 1964 J. Lewis s.n. **G5:SU**

Desmodium nudiflorum (L.) DC., 1957 L.K. Henry s.n.

Desmodium paniculatum (L.) DC. var. *paniculatum,* 1957 L.K. Henry s.n.
Desmodium perplexum Schub., 2006 L. Speedy LS-06-831
Gleditsia triacanthos L., 2007 L. Speedy 07-1642
Glycine max (L.) Merr., 1933 J. Bright 8614 East Asia
Lathyrus latifolius L., 2007 L. Speedy and M. Bowers 07-677 Europe
Lathyrus venosus Muhl. ex Willd., 2001 S.P. Grund and L. Smith 2561 **G5:S2**
Lespedeza capitata Michx., 1950 L.K. Henry and W.E. Buker s.n.
Lespedeza frutescens (L.) Hornem., 2006 L. Speedy and M. Bowers LS-06-800
Lespedeza hirta (L.) Hornem. ssp. *hirta,* 1950 L.K. Henry and W.E. Buker s.n.
Lespedeza repens (L.) W. Bart., 1915 J. Bright s.n.
Lotus corniculatus L., 2004 E.A. Zimmerman 217 Europe
Lupinus perennis L. ssp. *perennis* var. *occidentalis* S. Wats., 1948 W.E. Buker s.n. **G5:S3**
Medicago lupulina L., 1999 S.P. Grund and et al. 2351 Eurasia
Melilotus officinalis (L.) Lam., 1999 R.B. Coxe s.n. Eurasia
Phaseolus polystachyios (L.) B.S.P. var. *polystachyios,* 1924 J. Bright s.n. **G5:S1S2**
Robinia pseudoacacia L., 2007 L. Speedy 07-1694
Senna hebecarpa (Fern.) Irwin & Barneby, 1922 O.E. Jennings s.n.
Stylosanthes biflora (L.) B.S.P., 1995 J.A. Isaac 8062 **G5:S2**
Tephrosia virginiana (L.) Pers., 1939 C.M. Boardman s.n.
Trifolium aureum Pollich, 2004 E.A. Zimmerman 218 Eurasia
Trifolium campestre Schreb., 1995 B.L. Isaac and J.A. Isaac 7566 Europe
Trifolium hybridum L., 1904 O.E. Jennings s.n. Eurasia
Trifolium pratense L., 2004 E. Zimmerman 289 Europe
Trifolium repens L., 2004 E. Zimmerman 284 Europe
Vicia caroliniana Walt., 1946 H.N. Mozingo s.n.
Wisteria sinensis (Sims) DC., 2007 L. Speedy and M. Bowers LS-07-249 China

Fagaceae

Castanea dentata (Marsh.) Borkh., 2006 L. Speedy LS-06-403
Fagus grandifolia Ehrh., 2007 L. Speedy 07-1580
Quercus alba L., 2006 L. Speedy LS06-210-1
Quercus bicolor Willd., 1999 R.B. Coxe s.n.
Quercus ×*brittonii* W.T. Davis (pro sp.), 1940 Jennings, O.E. s.n.
Quercus coccinea Muenchh. var. *coccinea,* 1945 O.E. Jennings s.n.
Quercus ilicifolia Wangenh., 1969 S. Chamberlain s.n.
Quercus imbricaria Michx., 2007 L. Speedy and M. Bowers 07-676
Quercus muhlenbergii Engelm., 1910 O.E. Jennings and G.K. Jennings s.n.
Quercus palustris Muenchh., 2000 R. Coxe s.n.
Quercus prinus L., 2007 L. Speedy 07-1811
Quercus rubra L. var. *ambigua* (Gray) Fern., 2007 L. Speedy 07-1076-1
Quercus rubra L. var. *rubra,* 2007 L. Speedy 07-1648-1
Quercus velutina Lam., 2007 L. Speedy and Botanical Society of Western PA 07-1555-2

Fumariaceae

Adlumia fungosa (Ait.) Greene ex B.S.P., 2004 R. Coxe s.n.
Corydalis flavula (Raf.) DC., 2006 L. Speedy LS-06-6
Corydalis sempervirens (L.) Pers., 1992 J.A. Isaac 3905
Dicentra canadensis (Goldie) Walp., 2006 L. Speedy LS-06-35
Dicentra cucullaria (L.) Bernh., 2007 L. Speedy LS-07-13

Gentianaceae

Bartonia virginica (L.) B.S.P., 2006 L. Speedy and T. Pearson and D. Bryant LS-06-779
Gentiana andrewsii Griseb. var. *andrewsii,* 1981 F.H. Utech 81-427
Gentiana clausa Raf., 2007 L. Speedy 07-1662
Gentiana linearis Froel., 1952 L.K. Henry and W.E. Buker s.n.
Gentiana saponaria L. var. *saponaria,* 2006 L. Speedy and Botanical Society of Western PA LS-06-1035 **G5:S1S2**

Geraniaceae

Geranium columbinum L., 1964 J.F. Lewis s.n. Europe
Geranium maculatum L., 2006 L. Speedy LS-06-190

Grossulariaceae

Ribes cynosbati L., 2007 L. Speedy 07-624
Ribes rotundifolium Michx., 1999 R.B. Coxe s.n.
Ribes rubrum L., 1995 J.A. Isaac 7047 Eurasia

Haloragaceae

Myriophyllum heterophyllum Michx., 1997 S.P. Grund 2001 **G5: S1**

Hamamelidaceae

Hamamelis virginiana L., 2007 L. Speedy 07-1849

Hippocastanaceae

Aesculus flava Ait., 2007 L. Speedy and Botanical Society of Western PA 07-1613-1
Aesculus glabra Willd., 1957 L.K. Henry s.n.

Hydrangeaceae

Deutzia scabra Thunb., 2007 L. Speedy 07-1649 Asia
Hydrangea arborescens L., 2006 L. Speedy LS-06-944

Hydrocharitaceae

Elodea nuttallii (Planch.) St. John, 1977 M. Polechko s.n.
Vallisneria americana Michx., 2006 L. Speedy and D.Sofran LS-06-932

Hydrophyllaceae

Hydrophyllum appendiculatum Michx., 2006 L. Speedy LS-06-182
Hydrophyllum canadense L., 1997 S.P. Grund 2019
Hydrophyllum virginianum L., 2006 L. Speedy LS-06-183
Phacelia purshii Buckl., 2006 L. Speedy LS-06-180

Iridaceae

Iris germanica L., 1951 W.E. Buker s.n. Europe
Iris prismatica Pursh ex Ker-Gawl., 1942 O.E. Jennings s.n. **G4G5:S1**
Iris versicolor L., 1942 O.E. Jennings s.n.
Sisyrinchium angustifolium P. Mill., 1999 R.B. Coxe s.n.

Juglandaceae

Carya alba (L.) Nutt. ex Ell., 2006 L. Speedy LS06-977-2
Carya cordiformis (Wangenh.) K. Koch, 2006 L. Speedy and M. Bowers LS-06-528
Carya glabra (P. Mill) Sweet, 1950 O.E. Jennings s.n.
Carya ovalis (Wangenh.) Sarg., 1949 O.E. Jennings and E.H. Graham s.n.
Carya ovata (P. Mill) K. Koch, 2006 L. Speedy LS06-976-1
Juglans cinerea L., 2006 L. Speedy and J. Nusser and M. Bowers LS06-599-1
Juglans nigra L., 1920 O.E. Jennings s.n.

Juncaceae

Juncus acuminatus Michx., 2006 L. Speedy and K. Jurkovic LS-06-684
Juncus articulatus L., 1999 S.P. Grund and et al. 2346
Juncus brachycephalus (Engelm.) Buch., 1947 O.E. Jennings s.n. **G5:S2**
Juncus brevicaudatus (Engelm.) Fern., 2007 L. Speedy 07-1614
Juncus bufonius L. var. *bufonius*, 1929 O.E. Jennings s.n.
Juncus canadensis J. Gay ex Laharpe, 2006 L. Speedy and T. Pearson and D. Bryant LS-06-784
Juncus debilis Gray, 2006 L. Speedy and K. Jurkovic LS-06-707 **G5:S3**
Juncus dudleyi Wieg., 1924 J. Bright s.n
Juncus effusus L. var. *pylaei* (Laharpe) Fern. & Wieg., 2006 L. Speedy and K. Jurkovic LS-06-711
Juncus effusus L. var. *solutus* Fern. & Wieg., 2006 L. Speedy and M. Bowers LS-06-794
Juncus marginatus Rostk., 2000 R.B. Coxe s.n.
Juncus subcaudatus (Engelm.) Coville & Blake var. *subcaudatus*, 1999 S.P. Grund and R. Coxe and E. Copeland 2358
Juncus tenuis Willd., 2006 L. Speedy and M. Bowers LS-06-795
Luzula acuminata Raf. var. *acuminata*, 2006 L. Speedy LS-06-140
Luzula acuminata Raf. var. *carolinae* (S. Wats.) Fern., 1915 J. Bright s.n.
Luzula echinata (Small) F.J. Herm., 1938 L.K. Henry s.n.
Luzula multiflora (Ehrh.) Lej. ssp. *multiflora* var. *multiflora*, 2007 L. Speedy LS-07-130

Lamiaceae

Agastache nepetoides (L.) Kuntze, 1939 W.G. Burig s.n.
Ajuga reptans L., 1920 J. Bright s.n. Eurasia
Blephilia ciliata (L.) Benth., 1950 L.K. Henry and W.E. Buker s.n.
Blephilia hirsuta (Pursh) Benth. var. *hirsuta*, 2000 R. Coxe s.n.
Clinopodium vulgare L., 2007 L. Speedy and M. Bowers 07-694
Collinsonia canadensis L., 2007 L. Speedy 07-1048
Cunila origanoides (L.) Britt., 1917 B.H. Patterson s.n.
Glechoma hederacea L., 1999 R.B. Coxe s.n. Eurasia
Hedeoma pulegioides (L.) Pers., 2007 L. Speedy 07-1630
Isanthus brachiatus (L.) B.S.P., 1953 L.K. Henry and F.H. Beer s.n.
Lamium maculatum L., 1995 A. Genovese #12 Eurasia, CUP
Leonurus cardiaca L. ssp. *cardiaca*, 1981 F.H. Utech 81-219 Asia
Lycopus americanus Muhl. ex W. Bart., 1999 R.B. Coxe s.n.
Lycopus uniflorus Michx. var. *uniflorus*, 1999 S.P. Grund and et al. 2350
Lycopus virginicus L., 2006 L. Speedy and M. Bowers LS-06-857
Meehania cordata (Nutt.) Britt., 2007 L. Speedy LS-07-414 **G5:S1**
Melissa officinalis L., 2007 L. Speedy 07-1697 Asia
Mentha aquatica L., 1924 J. Bright s.n. Eurasia
Mentha arvensis L., 1999 S.P. Grund and et al. 2334
Mentha spicata L., 1950 L.K. Henry and W.E. Buker s.n. Europe
Mentha ×villosa Huds. (pro sp.), 1942 O.E. Jennings s.n. Eurasia
Monarda clinopodia L., 2006 L. Speedy and M. Bowers LS-06-513
Monarda didyma L., 2006 L. Speedy and M. Bowers LS-06-512
Monarda fistulosa L. var. *fistulosa*, 1941 O.E. Jennings s.n.
Monarda media Willd., 2006 L. Speedy and J. Nusser LS-06-671
Nepeta cataria L., 2006 L. Speedy LS-06-574 Eurasia
Origanum vulgare L., 1934 J.F. Lewis s.n. Mediterranean
Prunella vulgaris L. ssp. *lanceolata* (W. Bart.) Hulten, 2004 E. Zimmerman 275
Pycnanthemum incanum (L.) Michx. var. *incanum*, 1932 J. Bright 7521
Pycnanthemum tenuifolium Schrad., 2006 L. Speedy LS-06-629
Pycnanthemum verticillatum (Michx.) Pers. var. *verticillatum*, 1950 W.E. Buker s.n.
Salvia lyrata L., 1995 B.L. Isaac and J.A. Isaac 7552
Scutellaria elliptica Muhl. ex Spreng. var. *elliptica*, 2007 L. Speedy 07-1024
Scutellaria elliptica Muhl. ex Spreng. var. *hirsuta* (Short & Peter) Fern., 1953 W.E. Buker s.n.
Scutellaria incana Biehler, 2006 L. Speedy LS-06-640
Scutellaria lateriflora L. var. *lateriflora*, 2007 L. Speedy and M. Bowers 07-918
Scutellaria saxatilis Riddell, 2006 L. Speedy and J. Nusser LS-06-590 **G3:S1**
Stachys palustris L., 1950 D.H. Krouse s.n.
Stachys tenuifolia Willd., 1976 P. Jeffrey #25, CUP
Teucrium canadense L. var. *canadense*, 1999 R.B. Coxe s.n.
Trichostema dichotomum L., 1953 L.K. Henry and F.H. Beer s.n.

Lauraceae

Lindera benzoin (L.) Blume var. *benzoin*, 2007 L. Speedy 07-1667
Sassafras albidum (Nutt.) Nees., 2006 L. Speedy LS-06-149

Lemnaceae

Spirodela polyrhiza (L.) Schleid., 1977 M. Polechko s.n.

Lentibulariaceae

Utricularia macrorhiza Le Conte, 2006 L. Speedy and K. Jurkovic LS-06-708

Liliaceae

Allium canadense L. var. *canadense,* 2006 L. Speedy LS-06-357

Allium cernuum Roth var. *cernuum,* 1941 O.E. Jennings s.n.

Allium tricoccum Ait., 2007 L. Speedy LS-07-124

Allium vineale L. ssp. *vineale,* 1995 B.L. Isaac and J.A. Isaac 7550 Europe

Chamaelirium luteum (L.) Gray, 1955 W.E. Buker s.n.

Clintonia borealis (Ait.) Raf., 1957 W.E. Buker s.n.

Clintonia umbellulata (Michx.) Morong, 2006 L. Speedy and D. Sofran LS-06-225

Erythronium americanum Ker-Gawl. ssp. *americanum,* 2006 L. Speedy LS-06-33

Hypoxis hirsuta (L.) Coville, 1950 W.E. Buker s.n.

Lilium canadense L. ssp. *editorum* (Fern.) Wherry, 1950 W.E. Buker s.n.

Lilium philadelphicum L. var. *philadelphicum,* 1947 W.E. Buker s.n.

Lilium superbum L., 2006 L. Speedy and D. Sofran LS-06-731

Maianthemum canadense Desf., 2006 L. Speedy and D. Sofran LS-06-222

Maianthemum racemosum (L.) Link ssp. *racemosum,* 2006 L. Speedy and D. Sofran LS-06-219 [*Smilacina racemosa* (L.) Desf.]

Maianthemum stellatum (L.) Link, 1999 S.P. Grund 2398 [*Smilacina stellatum* (L.) Desf.]

Medeola virginiana L., 2006 L. Speedy and K. Jurkovic LS-06-464

Muscari botryoides (L.) P. Mill., 1960 W.E. Buker s.n. Europe

Narcissus pseudonarcissus L., 1947 W.E. Buker s.n. Europe

Ornithogalum umbellatum L., 1950 L.K. Henry and F.H. Beer s.n. Europe

Polygonatum biflorum (Walt.) Ell. var. *commutatum* (J.A. & J.H. Schultes) Morong, 2006 L. Speedy LS-06-177

Polygonatum pubescens (Willd.) Pursh, 2006 L. Speedy LS-06-112

Prosartes lanuginosa (Michx.) D. Don, 2006 L. Speedy LS-06-1001

Stenanthium gramineum (Ker-Gawl.) Morong var. *gramineum,* 1924 J. Bright s.n. **G4G5:S1S2**

Streptopus lanceolatus (Ait.) Reveal var. *lanceolatus,* 1940 O.E. Jennings and J.F. Lewis s.n.

Trillium erectum L., 2006 L. Speedy LS-06-39

Trillium grandiflorum (Michx.) Salisb., 2006 L. Speedy LS-06-50

Trillium undulatum Willd., 2007 L. Speedy LS-07-384

Uvularia grandiflora Sm., 2006 L. Speedy LS-06-622

Uvularia perfoliata L., 2007 L. Speedy LS-07-411

Uvularia puberula Michx., 2006 L. Speedy and M. Bowers LS-06-276

Uvularia sessilifolia L., 2006 L. Speedy LS-06-166

Veratrum viride Ait., 1999 R.B. Coxe s.n.

Limnanthaceae

Floerkea proserpinacoides Willd., 2006 L. Speedy LS-06-55

Linaceae

Linum striatum Walt., 2006 L. Speedy and K. Jurkovic LS-06-686

Linum virginianum L. var. *virginianum,* 1941 O.E. Jennings s.n.

Lythraceae

Cuphea viscosissima Jacq., 1919 O.E. Jennings s.n.

Lythrum salicaria L., 2006 L. Speedy LS-06-841 Europe

Magnoliaceae

Liriodendron tulipifera L., 2006 L. Speedy LS-06-1000

Magnolia acuminata (L.) L., 2006 L. Speedy LS-06-566

Magnolia macrophylla Michx., 1932 O.E. Jennings s.n.

Magnolia tripetala (L.) L., 1999 R.B. Coxe s.n. **G5:S2**

Malvaceae

Abutilon theophrasti Medik, 1873 B.H. Patterson s.n. Asia

Hibiscus syriacus L., 1883 J.A. Koch s.n. Asia

Malva moschata L., 1948 L.K. Henry s.n. Europe

Sida spinosa L., 1950 L.K. Henry and W.E. Buker s.n.

Melastomataceae

Rhexia virginica L., 2006 L. Speedy and D. Sofran LS-06-734

Menispermaceae

Menispermum canadense L., 2007 L. Speedy 07-1464

Mollunginaceae

Mollugo verticillata L., 1939 W.G. Burig s.n.

Monotropaceae

Monotropa hypopithys L., 1999 S.P. Grund 2354

Monotropa uniflora L., 1951 L.K. Henry and W.E. Buker s.n.

Moraceae

Maclura pomifera (Raf.) Schneid., 1952 A.W. Buvinger s.n., PH

Morus alba L., 2006 L. Speedy LS-06-370 Asia

Morus rubra L. var. *rubra,* 1931 O.E. Jennings s.n.

Najadaceae

Najas gracillima (A. Braun ex Engelm.) Magnus, 1977 M. Polechko s.n.

Najas minor All., 1977 M. Polechko s.n. Europe

Nyctaginaceae

Mirabilis nyctaginea (Michx.) MacM., 1951 L.K. Henry and W.E. Buker s.n.

Oleaceae

Fraxinus americana L., 2007 L. Speedy and M. Bowers 07-934

Fraxinus nigra Marsh., 1999 R.B. Coxe s.n.

Fraxinus pennsylvanica Marsh., 1934 J.F. Lewis s.n.

Ligustrum obtusifolium Sieb. & Zucc., 2006 L. Speedy LS-06-366 Japan

Ligustrum vulgare L., 1999 R.B. Coxe s.n. Europe

Onagraceae

Chamerion angustifolium (L.) Holub ssp. *circumvagum* (Mosquin) Kartesz, 1947 W.E. Buker s.n.

Circaea alpina L. ssp. *alpina,* 1950 W.E. Buker s.n.

Circaea xintermedia Ehrh. (pro sp.), 1941 O.E. Jennings s.n.

Circaea lutetiana L. ssp. *canadensis* (L.) Aschers. & Magnus, 1995 B.L. Isaac and J.A. Isaac 7558

Epilobium coloratum Biehler, 2006 L. Speedy and BSWP LS-06-753

Epilobium leptophyllum Raf., 1965 L.K. Henry s.n.

Gaura biennis L., 1982 F.H. Utech and M. Ohara 82-398
Ludwigia alternifolia L., 2006 L. Speedy and K. Jurkovic LS-06-682
Ludwigia palustris (L.) Ell., 1977 M. Polechko s.n.
Oenothera biennis L., 1950 L.K. Henry and W.E. Buker s.n.
Oenothera fruticosa L. ssp. *fruticosa,* 1924 R.R. Dreisbach 3131
Oenothera fruticosa L. ssp. *glauca* (Michx.) Straley, 1981 F.H. Utech 81-249, PH
Oenothera perennis L., 1954 W.E. Buker s.n.

Orchidaceae

Arethusa bulbosa L., 1950 W.E. Bukerand L.K. Henry and F.H. Beer and M. Henrici s.n. **G4:S1**
Calopogon tuberosus (L.) B.S.P. var. *tuberosus,* 1948 W.E. Buker s.n.
Corallorhiza maculata (Raf.) Raf. var. *maculata,* 1950 W.E. Buker s.n.
Corallorhiza odontorhiza (Willd.) Poir. var. *odontorhiza,* 1968 W.E. Buker s.n.
Cypripedium acaule Ait., 1997 J.S. Shriver and A. Shriver and C. Smith 870
Cypripedium parviflorum Salisb. var. *pubescens* (Willd.) Knight, 1997 J.S. Shriver and A. Shriver and C. Smith 869
Galearis spectabilis (L.) Raf., 1962 W.E. Buker s.n.
Goodyera pubescens (Willd.) R. Br. ex Ait. f., 2006 L. Speedy LS-06-56
Isotria verticillata Raf., 2007 L. Speedy and M. Bowers 07-681
Liparis liliifolia (L.) L.C. Rich. ex Ker-Gawl, 2004 E.A. Zimmerman 211
Liparis loeselii (L.) L.C. Rich., 1965 W.E. Buker s.n.
Malaxis bayardii Fern., 1973 P. Monk s.n. **G1G2:S1**
Malaxis unifolia Michx., 1973 P. Monk s.n.
Platanthera ciliaris (L.) Lindl., 1947 O.E. Jennings s.n. **G5:S2**
Platanthera clavellata (Michx.) Luer, 1947 O.E. Jennings s.n.
Platanthera flava (L.) Lindl. var. *herbiola* (R. Br. ex Ait. F.) Luer, 1948 W.E. Buker s.n.
Platanthera grandiflora (Bigelow) Lindl., 1968 A. Molans s.n.
Platanthera lacera (Michx.) G. Don, 1948 W.E. Buker s.n.
Platanthera orbiculata (Pursh) Lindl., 2006 L. Speedy and J. Nusser LS-06-593
Platanthera peramoena (Gray) Gray, 1996 J.S. Shriver and A. Shriver and C.Smith 659 **G5:S2**
Pogonia ophioglossoides (L.) Ker-Gawl., 2006 L. Speedy and K. Jurkovic LS-06-700
Spiranthes cernua (L.) L.C. Rich., 2006 L. Speedy and Botanical Society of Western PA LS-06-1038
Spiranthes lacera (Raf.) Raf. var. *gracilis* (Bigelow) Luer, 1995 J.A. Isaac 8065
Spiranthes lucida (H.H.Eat.) Ames, 1940 O.E. Jennings s.n. **G5:S3**
Spiranthes ochroleuca (Rybd.) Rybd., 1956 W.E. Buker s.n.

Orobanchaceae

Conopholis americana (L.) Wallr. f., 2006 L. Speedy and M. Bowers LS-06-270
Epifagus virginiana (L.) W. Bart., 2006 L. Speedy LS-06-971
Orobanche uniflora L., 2006 L. Speedy LS-06-109

Oxalidaceae

Oxalis dillenii Jacq., 1970 L.K. Henry s.n.
Oxalis grandis Small, 1951 L.K. Henry and W.E. Buker s.n.
Oxalis montana Raf., 1886 J.A. Shafer s.n.
Oxalis stricta L., 2007 L. Speedy 07-1698
Oxalis violacea L., 2007 L. Speedy and M. Bowers LS-07-245

Papaveraceae

Chelidonium majus L. var. *majus,* 1981 F.H. Utech 81-142 Eurasia
Sanguinaria canadensis L., 2006 L. Speedy LS-06-114

Passifloraceae

Passiflora lutea L., 1969 W.E. Buker s.n. **G5:S1**

Phytolaccaceae

Phytolacca americana L. var. *americana,* 2007 L. Speedy 07-1699

Plantaginaceae

Plantago lanceolata L., 2004 E. Zimmerman 285 Europe
Plantago major L., 1942 O.E. Jennings s.n.
Plantago rugelii Dcne. var. *rugelii,* 2006 L. Speedy LS-06-980
Plantago virginica L., 1938 W.R. Witz s.n.

Platanaceae

Platanus occidentalis L., 2007 L. Speedy 07-1050-1

Poaceae

Agrostis capillaris L., 1946 R.W. Pohl 5954 Europe, PH
Agrostis gigantea Roth, 2006 L. Speedy and K. Jurkovic LS-06-683 Europe
Agrostis perennans (Walt.) Tuckerman, 2006 L. Speedy LS-06-1010
Agrostis scabra Willd. 2006 L. Speedy LS-06-985
Andropogon gerardii Vitman, 2006 L. Speedy and D. Sofran LS-06-733
Andropogon glomeratus (Walt.) B.S.P. var. *glomeratus,* 2006 L. Speedy and T. Pearson and D. Bryant LS-06-762 **G5:S3**
Andropogon virginicus L. var. *virginicus,* 2006 L. Speedy LS-06-986
Anthoxanthum odoratum L. ssp. *odoratum,* 2007 L. Speedy LS-07-406 Eurasia
Aristida dichotoma Michx. var. *dichotoma,* 1906 O.E. Jennings and G.K. Jennings s.n.
Arrhenatherum elatius (L.) Beauv. ex J. & K. Presl var. *elatius,* 1980 F.H. Utech 80-153a Europe
Arthraxon hispidus (Thunb.) Makino, 2006 L. Speedy and D. Sofran LS-06-931 Southeast Asia
Calamagrostis canadensis (Michx.) Beauv. var. *canadensis,* 2006 L. Speedy LS-06-452
Calamagrostis coarctata (Torr.) Eat., 2006 L. Speedy and T. Pearson and D. Bryant LS-06-785
Chasmanthium latifolium (Michx.) Yates, 2006 L. Speedy LS-06-631 **G5:S1**
Cinna arundinacea L., 2006 L. Speedy LS-06-975
Brachyelytrum erectum (Schreb. ex Spreng.) Beauv., 2007 L. Speedy 07-615
Brachyelytrum septentrionale (Babel) G. Tucker, 2006 L. Speedy and M. Bowers LS-06-861
Bromus commutatus Schrad., 1951 W.E. Buker s.n. Europe

Bromus hordeaceus L. ssp. *hordeaceus,* 1995 B.L. Isaac and J.A. Isaac 7568 Europe

Bromus inermis Leyss. ssp. *inermis* var. *inermis,* 2004 E. Zimmerman 288 Europe

Bromus pubescens Muhl. ex Willd., 2006 L. Speedy and M. Bowers LS-06-527

Dactylis glomerata L. ssp. *glomerata,* 1987 F.H. Utech 87-130 Europe

Danthonia compressa Austin ex Peck, 2006 L. Speedy LS-06-558

Danthonia spicata (L.) Beauv. ex Roemer & J.A. Schultes, 2006 L. Speedy LS-06-554

Deschampsia flexuosa (L.) Trin. var. *flexuosa,* 1938 O.E. Jennings s.n.

Diarrhena americana Beauv., 2007 L. Speedy 07-1666 **G4?S1**

Dichanthelium acuminatum (Sw.) Gould & C.A. Clark var. *fasciculatum* (Torr.) Freckmann, 1934 O.E. Jennings s.n.

Dichanthelium boreale (Nash) Freckmann, 1965 W.E. Buker s.n.

Dichanthelium boscii (Poir.) Gould & C.A. Clark, 1995 B.L. Isaac and J.A. Isaac 7547

Dichanthelium clandestinum (L.) Gould, 2006 L. Speedy LS-06-983

Dichanthelium commutatum (J.A. Schultes) Gould, 1931 J. Bright 5459

Dichanthelium depauperatum (Muhl.) Gould, 1942 O.E. Jennings s.n.

Dichanthelium dichotomum (L.) Gould var. *dichotomum,* 2006 L. Speedy LS-06-984

Dichanthelium latifolium (L.) Gould & C.A. Clark, 1947 O.E. Jennings s.n.

Dichanthelium linearifolium (Scribn. ex Nash) Gould, 1934 O.E. Jennings s.n.

Dichanthelium meridionale (Ashe) Freckmann, 1955 W.E. Buker s.n.

Dichanthelium sabulorum (Lam.) Gould & C.A Clark var. *thinium* (A.S. Hitchc. & Chase) Gould & C.A. Clark, 2006 L. Speedy LS-06-557

Dichanthelium sphaerocarpon (Ell.) Gould var. *isophyllum* (Scribn.) Gould & C.A. Clark, 1953 W.E. Buker s.n.

Dichanthelium sphaerocarpon (Ell.) Gould var. *sphaerocarpon,* 1931 J. Bright 5421

Digitaria ischaemum (Schreb.) Schreb. ex Muhl., 1995 Isaac, J.A. 8396 Eurasia

Digitaria sanguinalis (L.) Scop., 1997 Grund, S.P. 2010

Echinochloa crus-galli (L.) Beauv., 2004 E. Zimmerman 287 Eurasia

Echinochloa muricata (Beauv.) Fern. var. *muricata,* 1950 L.K. Henry and W.E. Buker s.n.

Eleusine indica (L.) Gaertn., 1915 J. Bright s.n. Old World Tropics

Elymus hystrix L. var. *hystrix,,* 2006 L. Speedy LS-06-618

Elymus repens (L.) Gould, 1928 J. Bright s.n. Eurasia

Elymus riparius Wieg., 2006 L. Speedy and D. Sofran LS-06-732

Elymus virginicus L. var. *virginicus,* 2007 L. Speedy and J. Nusser 07-607

Eragrostis capillaris (L.) Nees, 1924 J. Bright s.n.

Eragrostis hypnoides (Lam.) B.S.P., 2006 L. Speedy LS-06-967

Eragrostis pectinacea (Michx.) Nees ex Steud. var. *pectinacea,* 1915 J. Bright s.n.

Eragrostis spectabilis (Pursch.) Steud, 2006 L. Speedy LS-06-970

Festuca subverticillata (Pers.) Alexeev, 2007 L. Speedy and J. Nusser 07-597

Glyceria canadensis (Michx.) Trin., 2006 L. Speedy and K. Jurkovic LS-06-712

Glyceria grandis S. Wats. var. *grandis,* 2006 L. Speedy LS-06-436

Glyceria melicaria (Michx.) F.T. Hubbard, 2006 Speedy, L. LS-06-1004

Glyceria septentrionalis A.S. Hitchc., 1905 J.A. Shafer and G.E. Kinzer s.n.

Glyceria striata (Lam.) A.S. Hitchc., 2007 L. Speedy 07-549

Holcus lanatus L., 2006 L. Speedy LS-06-426 Europe

Leersia oryzoides (L.) Sw., 1982 F.H. Utech and M. Ohara 82-393

Leersia virginica Willd., 2007 L. Speedy 07-1636

Lolium arundinaceum (Schreb.) S.J. Darbyshire, 1995 B.L. Isaac and J.A. Isaac 7582 Europe

Lolium perenne L. ssp. *perenne,* 1907 J.A. Shafer s.n. Europe

Lolium pratense (Huds.) S.J. Darbyshire, 2007 L. Speedy 07-1715 Europe

Microstegium vimineum (Trin.) A. Camus, 2007 L. Speedy 07-1807 Tropical Asia

Muhlenbergia frondosa (Poir.) Fern., 1951 L.K. Henry and W.E. Buker s.n.

Muhlenbergia schreberi J.F. Gmel., 1901 J.A. Shafer s.n.

Muhlenbergia sylvatica Torr. ex Gray, 2007 L. Speedy 07-1717

Muhlenbergia tenuiflora (Willd.) B.S.P., 2006 L. Speedy and J. Nusser LS-06-675

Panicum capillare L., 1946 H.N. Mozingo s.n.

Panicum dichotomiflorum Michx. var. *dichotomiflorum,* 2007 L. Speedy and et al. 07-1605

Panicum gattingeri Nash, 1916 O.E. Jennings and G.K. Jennings and B. Patterson s.n.

Panicum philadelphicum Bernh. ex Trin., 1919 O.E. Jennings s.n.

Panicum rigidulum Bosc ex Nees var. *elongatum* (Pursh) Lelong, 1931 O.E. Jennings s.n.

Panicum rigidulum Bosc ex Nees var. *pubescens* (Vasey) Lelong, 1987 A.W. Cusick 26992

Panicum rigidulum Bosc ex Nees var. *rigidulum,* 1929 J. Bright 2352

Panicum verrucosum Muhl., 2006 L. Speedy and D. Sofran LS-06-936

Panicum virgatum L. var. *virgatum,* 2006 L. Speedy LS-06-988

Pennisetum glaucum (L.) R. Br., 1970 L.K. Henry s.n. Africa

Phalaris arundinacea L., 2006 L. Speedy and BSWP LS-06-749

Phleum pratense L., 1930 J. Bright 5042 Europe

Poa alsodes Gray, 2006 L. Speedy and K. Jurkovic LS-06-472

Poa annua L., 1942 O.E. Jennings s.n. Eurasia

Poa compressa L., 2007 L. Speedy and M. Bowers 07-686 Europe

Poa cuspidata Nutt., 2006 L. Speedy LS-06-11
Poa palustris L., 2006 L. Speedy and BSWP LS-06-751
Poa pratensis L. ssp. *pratensis,* 2007 L. Speedy LS-07-399
Poa saltuensis Fern. & Wieg., 2007 L. Speedy and J. Nusser 07-602
Poa sylvestris Gray, 1995 B.L. Isaac and J.A. Isaac 7089
Poa trivialis L., 2007 L. Speedy 07-546 Europe
Schizachyrium scoparium (Michx.) Nash var. *scoparium,* 1982 F.H. Utech and M. Ohara 82-394
Setaria faberi Herrm., 1970 W.E. Buker s.n. Eastern Asia
Setaria pumila (Poir.) Roemer & J.A. Schultes, 2006 L. Speedy LS-06-847 Europe
Setaria viridis (L.) Beauv. var. *viridis,* 2006 L. Speedy LS-06-958 Eurasia
Sorghastrum nutans (L.) Nash, 2006 L. Speedy LS-06-959
Spartina pectinata Bosc ex Link, 2006 L. Speedy and BSWP LS-06-754
Sphenopholis nitida (Biehler) Scribn., 1920 J. Bright s.n.
Tridens flavus (L.) A.S. Hitchc. var. *flavus,* 2007 L. Speedy 07-1066

Polemoniaceae

Phlox divaricata L. ssp. *divaricata,* 1987 F.H. Utech 87-144
Phlox divaricata L. ssp. *laphamii* (Wood) Wherry, 2006 L. Speedy LS-06-179
Phlox maculata L. ssp. *maculata,* 1981 F.H. Utech 81-119
Phlox maculata L. ssp. *pyramidalis* (Sm.) Wherry, 1951 L.K. Henry and W.E. Buker s.n.
Phlox paniculata L., 2006 L. Speedy LS-06-630
Phlox stolonifera Sims, 2006 L. Speedy LS-06-147
Polemonium reptans L. var. *reptans,* 2007 L. Speedy LS-07-119

Polygalaceae

Polygala ambigua Nutt., 2000 R.B. Coxe s.n.
Polygala cruciata L. var. *aquilonia* Fern. & Schub., 2006 L. Speedy and T. Pearson and D. Bryant LS-06-778 **G5:S1**
Polygala paucifolia Willd., 1905 O.E. Jennings s.n.
Polygala sanguinea L., 2006 L. Speedy and K. Jurkovic LS-06-689
Polygala verticillata L. var. *verticillata,* 1954 W.E. Buker s.n.

Polygonaceae

Fagopyrum esculentum Moench, 1942 O.E. Jennings s.n. Asia
Fallopia convolvulus (L.) A. Love, 1982 F.H. Utech and M. Ohara 82-397 Europe
Fallopia japonica (Houtt.) R. Decr., 2007 L. Speedy 07-1693 Japan
Fallopia sachalinensis (F. Schmidt ex Maxim.) R. Decr., 2006 L. Speedy LS-06-989 Japan
Fallopia scandens (L.) Holub, 2007 L. Speedy 07-1701
Persicaria amphibia var. *emersa* (Michx.) Hickman, 2006 L. Speedy and BSWP LS-06-750 *Persicaria hydropiper* (L.) Opiz, 1946 O.E. Jennings s.n. Europe
Persicaria hydropiperoides (Michx.) Small, 2007 L. Speedy 07-1635
Persicaria lapathifolia (L.) S.F. Gray, 1999 S.P. Grund and et al. 2341
Persicaria longiseta (de Bruijn) Moldenke, 2006 L. Speedy LS-06-353
Persicaria maculosa S.F. Gray, 1999 R.B. Coxe s.n. Europe
Persicaria nepalensis (Meisn.) H. Gross, 1997 A.L. Woolston 3062 Asia
Persicaria orientalis (L.) Assenov, 1944 O.E. Jennings s.n. India
Persicaria pensylvanica (L.) Small, 2006 L. Speedy LS-06-844
Persicaria punctatum (Ell.) Small, 2007 L. Speedy 07-1734
Persicaria sagittatum (L.) Gross, 2000 R.B. Coxe s.n.
Persicaria virginiana (L.) Gaertn., 2007 L. Speedy 07-1075
Polygonum aviculare L., 1991 S.A. Thompson 8891 Europe
Polygonum cilinode Michx., 1999 R.B. Coxe s.n.
Rumex acetosella L., 2006 L. Speedy LS-06-431 Eurasia
Rumex crispus L. ssp. *crispus,* 1991 S.A. Thompson 8906 Europe
Rumex obtusifolius L., 2004 E.A. Zimmerman 214 Europe

Portulacaceae

Claytonia caroliniana Michx. var. *caroliniana,* 2006 L. Speedy LS-06-101
Claytonia virginica L. var. *virginica,* 2006 L. Speedy LS-06-48
Portulaca grandiflora Hook., 1900 J.A. Shafer s.n. Argentina

Potamogetonaceae

Potamogeton amplifolius Tuckerman, 1999 S.P. Grund and et al. 2274
Potamogeton crispus L., 2006 L. Speedy and BSWP LS-06-759 Europe
Potamogeton diversifolius Raf. var. *diversifolius,* 1997 S.P. Grund 2016
Potamogeton epihydrus Raf., 1977 M. Polechko s.n.
Potamogeton foliosus Raf. ssp. *foliosus,* 1977 M. Polechko s.n.
Potamogeton nodosus Poir., 1977 M. Polechko s.n.
Potamogeton tennesseensis Fern., 2006 L. Speedy and BSWP LS-06-758 **G2:S1**

Primulaceae

Anagallis arvensis L. ssp. *arvensis,* 1901 J.A. Shafer s.n. Eurasia
Lysimachia ciliata L., 2006 L. Speedy and M. Bowers LS-06-523
Lysimachia lanceolata Walt., 1959 O.E. Jennings s.n.
Lysimachia nummularia L., 2004 E. Zimmerman 286 Europe
Lysimachia quadrifolia L., 2007 L. Speedy and M. Bowers 07-664
Lysimachia ×producta (Gray) Fern. (pro sp.), 1916 B.H. Patterson s.n.
Lysimachia terrestris (L.) B.S.P., 2006 L. Speedy and M. Bowers LS-06-869

Pyrolaceae

Pyrola americana Sweet, 1976 W.E. Buker s.n.
Pyrola elliptica Nutt., 1905 J.A. Shafer and G.E. Kinzer s.n.

Ranunculaceae

Aconitum reclinatum Gray, 1999 S.P. Grund and R. Coxe and E. Copeland 2368 **G3:S1**
Aconitum uncinatum L. ssp. *muticum* (DC.) Hardin, 2006 L. Speedy and BSWP LS-06-752 **G4:S2**
Actaea pachypoda Ell., 1932 W.R. Van Dersal s.n.
Actaea podocarpa DC., 2006 L. Speedy LS06-996-1

Actaea racemosa L. var. *racemosa,* 2006 L. Speedy and M. Bowers LS-06-511 [*Cimicifuga racemosa* (L.) Nutt.]
Anemone quinquefolia L. var. *quinquefolia,* 2006 L. Speedy LS-06-136
Anemone virginiana L. var. *virginiana,* 2006 L. Speedy LS-06-570
Aquilegia canadensis L., 1987 F.H. Utech 87-173
Aquilegia vulgaris L., 1962 W.E. Buker s.n. Europe
Caltha palustris L. var. *palustris,* 2007 L. Speedy LS-07-115
Clematis virginiana L., 2007 L. Speedy 07-1021
Delphinium exaltatum Ait., 1994 J.D. Wagner and C.J. Boget 657 **G3:S1**
Delphinium tricorne Michx., 2006 L. Speedy LS-06-100
Hepatica nobilis Schreber var. *acuta* (Pursh) Steyermark, 2006 L. Speedy LS-06-16
Hepatica nobilis Schreber var. *obtusa* (Pursh) Steyermark, 1964 L.K. Henry s.n
Hydrastis canadensis L., 2007 L. Speedy LS-07-397
Ranunculus abortivus L., 2006 L. Speedy LS-06-108
Ranunculus acris L. var. *acris,* 2006 L. Speedy LS-06-350 Europe
Ranunculus allegheniensis Britt., 1999 R.B. Coxe s.n.
Ranunculus hispidus Michx. var. *caricetorum* (Greene) T. Duncan, 1920 O.E. Jennings s.n.
Ranunculus hispidus Michx. var. *hispidus,* 2006 L. Speedy LS-06-40
Ranunculus hispidus Michx. var. *nitidus* (Chapman) T. Duncan, 1957 L.K. Henry s.n., PH
Ranunculus micranthus Nutt., 1997 S.P. Grund 1789
Ranunculus recurvatus Poir. var. *recurvatus,* 2006 L. Speedy LS-06-174
Ranunculus repens L., 1999 R.B. Coxe s.n. Europe
Thalictrum coriaceum (Britt.) Small, 2005 C.M. Bowers s.n. **G4:S2**
Thalictrum dioicum L., 2007 L. Speedy LS-07-270
Thalictrum pubescens Pursh, 2006 L. Speedy and M. Bowers LS-06-522
Thalictrum thalictroides (L.) Eames & Boivin, 2006 L. Speedy LS-06-10
Trautvetteria caroliniensis (Walt.) Vail var. *caroliniensis,* 2007 L. Speedy 07-1036 **G5:S3**

Rhamnaceae

Ceanothus americanus L., 1985 C.W. Bier s.n.
Frangula alnus P. Mill., 2007 L. Speedy 07-1705 Europe

Rosaceae

Agrimonia gryposepala Wallr., 2006 L. Speedy and J. Nusser LS-06-582
Agrimonia parviflora Ait., 2007 L. Speedy 07-1025
Agrimonia pubescens Wallr., 1957 L.K. Henry s.n.
Agrimonia rostellata Wallr., 1953 W.E. Buker s.n.
Agrimonia striata Michx., 1999 R.B. Coxe s.n.
Amelanchier arborea (Michx. f.) Fern. var. *arborea,* 2006 L. Speedy LS-06-439
Amelanchier canadensis (L.) Medik., 1908 O.E. Jennings s.n. **G5:SNR**
Amelanchier ×intermedia Spach (pro sp.), 1963 O.E. Jennings s.n.
Amelanchier laevis Wieg., 2006 L. Speedy LS-06-130
Amelanchier stolonifera Wieg., 2007 L. Speedy 07-136
Aruncus dioicus (Walt.) Fern. var. *dioicus,* 2007 L. Speedy 07-1660
Crataegus dodgei Ashe, 1920 O.E. Jennings s.n.
Crataegus macrosperma Ashe, 2006 L. Speedy LS-06-1017
Crataegus phaenopyrum (L. f.) Medik., 1946 J. Lewis s.n.
Crataegus pruinosa (Wendle. f.) K. Koch, 1902 W.M. Canby and C.S. Sargent and B.F. Bush 38
Dalibarda repens L., 1954 W.E. Buker s.n.
Duchesnea indica (Andr.) Focke, 2006 L. Speedy LS-06-953 Asia
Fragaria vesca L. ssp. *vesca,* 1955 L.K. Henry s.n.
Fragaria virginiana Duchesne ssp. *virginiana,* 2007 L. Speedy LS-07-189
Geum canadense Jacq. var. *canadense,* 2007 L. Speedy and J. Nusser 07-599
Geum vernum (Raf.) Torr. & Gray, 1920 O.E. Jennings s.n.
Geum virginianum L., 1934 J. Bright 9651
Malus coronaria (L.) P. Mill., 2006 L. Speedy LS-06-165
Malus floribunda Sieb. ex Van Houtte, 2007 L. Speedy 07-1463 Asia
Malus pumila P. Mill., 1934 E.H. Graham s.n. [*Pyrus malus* L.] Eurasia
Photinia floribunda (Lindl.) Robertson & Phipps, 1946 O.E. Jennings s.n. [*Pyrus floribunda* Lindl.]
Photinia melanocarpa (Michx.) Robertson & Phipps, 2006 L. Speedy LS-06-163 [*Pyrus melanocarpa* (Michx.) Willd.]
Photinia pyrifolia (Lam.) Robertson & Phipps, 1922 O.E. Jennings s.n. [*Pyrus floribunda* Lindl.]
Physocarpus opulifolius (L.) Maxim. var. *opulifolius,* 2007 L. Speedy 07-1035
Porteranthus trifoliatus (L.) Britt., 2006 L. Speedy LS-06-453
Potentilla canadensis L. var. *canadensis,* 2006 L. Speedy LS-06-159
Potentilla norvegica L. ssp. *monspeliensis* (L.) Aschers & Graebn., 1999 R.B. Coxe s.n.
Potentilla recta L., 2007 L. Speedy LS-07-402 Europe
Potentilla simplex Michx., 2007 L. Speedy and M. Bowers LS-07-246
Prunus americana Marsh. var. *americana,* 1954 L.K. Henry and W.E. Buker s.n.
Prunus avium (L.) L., 2007 L. Speedy LS-07-17 Eurasia
Prunus pensylvanica L. f. var. *pensylvanica,* 2006 L. Speedy LS-06-145
Prunus persica (L.) Batsch, 2006 L. Speedy LS-06-99-1 Asia
Prunus serotina Ehrh. var. *serotina,* 2006 L. Speedy LS-06-202
Prunus virginiana L. var. *virginiana,* 2006 L. Speedy LS-06-639
Rosa carolina L. var. *carolina,* 2007 L. Speedy and M. Bowers 07-690
Rosa eglanteria L., 1918 J. Bright s.n. Europe
Rosa multiflora Thunb. Ex Murr., 2007 L. Speedy 07-1646 Asia
Rosa palustris Marsh., 1999 R.B. Coxe s.n.
Rosa wichuraiana Crepin, 2006 L. Speedy and M. Bowers LS-06-530 Asia
Rubus adjacens Fern., 1904 O.E. Jennings s.n.

Rubus allegheniensis Porter var. *allegheniensis,* 2006 L. Speedy LS-06-401
Rubus canadensis L., 1929 J. Bright 1866
Rubus fecundus Bailey, 1951 H.A. Davis and T. Davis 9466
Rubus flagellaris Willd., 2007 L. Speedy and M. Bowers LS-07-248
Rubus illecebrosus Focke, 1999 R.B. Coxe s.n. Japan
Rubus invisus (Bailey) Britt., 1950 H.A. Davis and T. Davis 9166
Rubus hispidus L., 2007 L. Speedy and Botanical Soc. of W Pa 07-642
Rubus laudatus Berger, 1955 H.A. Davis and T. Davis 10905
Rubus occidentalis L., 2006 L. Speedy and K. Jurkovic LS-06-476
Rubus odoratus L. var. *odoratus,* 2006 L. Speedy LS-06-368
Rubus paganus Bailey, 1950 H.A. Davis and T. Davis 9079
Rubus pensilvanicus Poir., 2006 L. Speedy LS-06-413
Rubus permixtus Blanch., 1950 H.A. Davis and T. Davis s.n.
Rubus plicatifolius Blanch., 1905 O.E. Jennings s.n.
Rubus provincialis Bailey, 1950 H.A. Davis and T. Davis s.n.
Rubus pubescens Raf. var. *pubescens,* 2006 L. Speedy and E. Richards LS-06-310
Rubus pugnax Bailey, 1950 H.A. Davis and T. Davis 9174
Rubus racemiger Bailey, 1951 H.A. Davis and T. Davis 9472
Rubus recurvicaulis Blanch., 2006 L. Speedy LS-06-443
Rubus roribaccus (Bailey) Rydb., 1955 H.A. Davis and T. Davis 10903
Rubus rosa Bailey, 1924 J. Bright s.n.
Rubus setosus Bigelow, 1951 H.A. Davis and T. Davis 9473 **G5:SH**
Rubus suus Bailey, 1906 O.E. Jennings and G.K. Jennings s.n.
Sanguisorba canadensis L., 1940 O.E. Jennings s.n.
Sorbus americana Marsh., 1946 O.E. Jennings s.n.
Spiraea alba Du Roi var. *alba,* 2007 L. Speedy and M. Bowers 07-856
Spiraea alba Du Roi var. *latifolia* (Ait.) Dippel, 1986 C. Bier and B. Woodworth and M. Bowers s.n.
Spiraea japonica L. f. var. *fortunei* (Planch.) Rehd., 2006 L. Speedy LS-06-998 Japan
Spiraea virginiana Britt., 1901 J.A. Shafer 343 **G2:SX**
Waldsteinia fragarioides (Michx.) Tratt. ssp. *fragarioides,* 1938 L.K. Henry s.n.

Rubiaceae

Cephalanthus occidentalis L., 1999 R.B. Coxe s.n.
Galium aparine L., 2006 L. Speedy LS-06-115
Galium asprellum Michx., 1991 S.A. Thompson 8901
Galium boreale L., 1904 O.E. Jennings s.n.
Galium circaezans Michx. var. *circaezans,* 2006 L. Speedy LS-06-617
Galium circaezans Michx. var. *hypomalacum* Fern., 1935 O.E. Jennings s.n.
Galium lanceolatum Torr., 1950 W.E. Buker s.n.
Galium latifolium Michx., 2004 R. Coxe s.n. **G5:S3**
Galium mollugo L., 2007 L. Speedy 07-1696 Eurasia
Galium pilosum Ait. var. *pilosum,* 1948 W.E. Buker s.n.
Galium tinctorium (L.) Scop., 2007 L. Speedy and M. Bowers 07-835
Galium trifidum L. ssp. *trifidum,* 1954 W.E. Buker s.n. **G5:S2**
Galium triflorum Michx., 1999 S.P. Grund and R. Coxe and E. Copeland 2366
Houstonia caerulea L., 2006 L. Speedy LS-06-113
Houstonia purpurea L. var. *purpurea,* 2007 L. Speedy 07-625 **G5T5:S1**
Houstonia serpyllifolia Michx., 2004 R. Coxe s.n. **G4?:S1**
Mitchella repens L., 2006 L. Speedy LS-06-148

Salicaceae

Populus alba L., 1950 W.E. Buker s.n. Eurasia
Populus ×canescens (Ait.) Sm. (pro sp.), 1901 J.A. Shafer s.n. Eurasia
Populus deltoides Bartr. Ex Marsh. ssp. *deltoides,* 1940 J.F. Lewis s.n.
Populus grandidentata Michx., 1999 R.B. Coxe s.n.
Populus ×jackii (cv. Balm of Gilead) Sarg., 1953 L.K. Henry and W.E. Buker s.n.
Populus tremuloides Michx., 1941 O.E. Jennings s.n.
Salix bebbiana Sarg., 1947 W.E. Buker s.n.
Salix eriocephala Michx., 1999 R.B. Coxe s.n.
Salix fragilis L., 2007 L. Speedy 07-1067 Europe
Salix humilis Marsh. var. *humilis,* 1953 L.K. Henry and W.E. Buker s.n.
Salix interior Rowlee, 2007 L. Speedy and M. Bowers 07-1608
Salix nigra Marsh., 2006 L. Speedy LS-06-361
Salix sericea Marsh., 2007 L. Speedy and M. Bowers 07-937
Salix serissima (Bailey) Fern., 1932 W.R. Van Dersal s.n. **G4:S2**

Santalaceae

Pyrularia pubera Michx., 2006 L. Speedy and M. Bowers LS-06-525 **G5:S3**

Sarraceniaceae

Sarracenia purpurea L. ssp. *gibbosa* (Raf.) Wherry, 2006 L. Speedy and E. Richards LS-06-306

Saxifragaceae

Chrysosplenium americanum Schwein. ex Hook., 2006 L. Speedy LS-06-154
Heuchera americana L. var. *americana,* 1987 F.H. Utech 87-165
Heuchera pubescens Pursh, 1968 H. Fong and et al. WP-1350
Mitella diphylla L., 2007 L. Speedy LS-07-413
Saxifraga micranthidifolia (Haw.) Steud., 2006 L. Speedy LS-06-139 **G5:S4**
Saxifraga pensylvanica L., 2007 L. Speedy LS-07-379
Saxifraga virginiensis Michx. var. *virginiensis,* 2007 L. Speedy LS-07-11
Tiarella cordifolia L. var. *cordifolia,* 2006 L. Speedy LS-06-138

Scrophulariaceae

Agalinis purpurea (L.) Pennell, 1929 J. Bright 2376
Aureolaria flava (L.) Farw. var. *flava,* 1947 L.K. Henry s.n.
Aureolaria laevigata (Raf.) Raf., 2006 L. Speedy LS-06-837
Aureolaria virginica (L.) Pennell, 2004 R. Coxe s.n.
Castilleja coccinea (L.) Spreng., 2007 L. Speedy LS-07-362 **G5:S2**
Chaenorhinum minus (L.) Lange, 2006 L. Speedy and E. Richards LS-06-312 Europe

Chelone glabra L., 2006 L. Speedy LS-06-1012

Collinsia verna Nutt., 2006 L. Speedy LS-06-170 **G5:S4**

Digitalis purpurea L. var. *purpurea,* 1905 J.A. Shafer and G.E. Kinzer s.n. Europe

Gratiola neglecta Torr., 2006 L. Speedy LS-06-437

Linaria vulgaris P. Mill., 1981 F.H. Utech 81-221 Eurasia

Lindernia dubia (L.) Pennell var. *dubia,* 2007 L. Speedy 07-1028

Melampyrum lineare Desr. var. *lineare,* 1947 W.E. Buker s.n.

Mimulus ringens L. var. *ringens,* 2007 L. Speedy and M. Bowers 07-920

Pedicularis canadensis L. ssp. *canadensis,* 2006 L. Speedy LS-06-1009

Pedicularis lanceolata Michx., 1903 O.P. Medsger s.n. **G5:S1S2**

Penstemon digitalis Nutt. ex Sims, 1952 C.M. Boardman s.n.

Scrophularia marilandica L., 2007 L. Speedy 07-1455

Verbascum blattaria L., 1999 R.B. Coxe s.n. Eurasia

Verbascum thapsus L., 1953 L.K. Henry and F.H. Beer s.n. Europe

Veronica americana Schwein. ex Benth., 2006 L. Speedy LS-06-351

Veronica chamaedrys L., 1920 J. Bright s.n. Eurasia

Veronica officinalis L. var. *officinalis,* 2006 L. Speedy LS-06-572

Veronica peregrina L. ssp. *peregrina,* 1939 O.E. Jennings s.n.

Veronica serpyllifolia L. ssp. *serpyllifolia,* 1932 W.R. VanDersal s.n. Europe

Veronicastrum virginicum (L.) Farw., 2006 L. Speedy LS-06-638

Simaroubaceae

Ailanthus altissima (P.Mill.) Swingle, 2006 L. Speedy LS-06-626 Asia

Smilacaceae

Smilax glauca Walt., 2006 L. Speedy LS-06-555

Smilax herbacea L., 2007 L. Speedy 07-1030

Smilax rotundifolia L., 2006 L. Speedy LS-06-203

Smilax tamnoides L., 1934 E.H. Graham s.n.

Solanaceae

Datura stramonium L., 1939 W.G. Burig s.n. exotic Mexico

Lycium barbarum L., 1950 L.K. Henry and W.E. Buker s.n. Eurasia

Physalis heterophylla Nees var. *heterophylla,* 1953 L.K. Henry and F.H. Beer s.n.

Physalis longifolia Nutt. var. *subglabrata* (Mackenzie & Bush) Cronq., 2007 L. Speedy 07-1053

Solanum carolinense L. var. *carolinense,* 1955 C.M. Boardman s.n.

Solanum dulcamara L. var. *dulcamara,* 2007 L. Speedy 07-1708 Eurasia

Solanum ptychanthum Dunal, 1900 J.A. Shafer s.n.

Sparganiaceae

Sparganium americanum Nutt., 2006 L. Speedy and T. Pearson and D. Bryant LS-06-788

Sparganium angustifolium Michx., 1908 O.E. Jennings s.n. **G5:S2**

Sparganium erectum L. ssp. *stoloniferum* (Graebn.) Hara, 1999 R.B. Coxe s.n.

Staphyleaceae

Staphylea trifolia L., 2006 L. Speedy LS-06-105

Thymelaeaceae

Dirca palustris L., 2007 L. Speedy and Botanical Society of Western PA 07-1611

Tiliaceae

Tilia americana L. var. *americana,* 2006 L. Speedy LS-06-951

Tilia americana L. var. *heterophylla* (Vent.) Loud., 2006 L. Speedy LS-06-371

Tilia cordata Tilia cordata P. Mill., 1934 A. Conn s.n. exotic Europe

Typhaceae

Typha latifolia L., 1991 S.A. Thompson 8888

Ulmaceae

Celtis occidentalis L., 2007 L. Speedy 07-1822

Celtis tenuifolia Nutt., 1950 W.E. Buker s.n.

Ulmus americana L., 2007 L. Speedy 07-1638

Ulmus rubra Muhl., 2006 L. Speedy LS-06-63

Urticaceae

Boehmeria cylindrica (L.) Sw., 1951 L.K. Henry and W.E. Buker s.n.

Laportea canadensis (L.) Weddell, 2006 L. Speedy and J. Nusser LS-06-665

Parietaria pensylvanica Muhl. ex Willd., 1970 L.K. Henry s.n.

Pilea pumila (L.) Gray var. *pumila,* 2007 L. Speedy 07-1821

Urtica dioica L. ssp. *gracilis* (Ait.) Seland., 1946 H.N. Mozingo s.n.

Valerianaceae

Valeriana pauciflora Michx., 2006 L. Speedy LS-06-181

Valerianella chenopodiifolia (Pursh) DC., 1950 L.K. Henry and F.H. Beer s.n.

Valerianella umbilicata (Sullivant) Wood, 1987 F.H. Utech 87-146

Verbenaceae

Phryma leptostachya L., 2006 L. Speedy LS-06-616

Verbena hastata L. var. *hastata,* 2007 L. Speedy and M. Bowers 07-862

Verbena simplex Lehm., 1948 W.E. Buker s.n.

Verbena urticifolia L. var. *urticifolia,* 1984 S.A. Thompson 1875

Violaceae

Hybanthus concolor (T.F. Forst.) Spreng., 2006 L. Speedy LS-06-619

Viola affinis Le Conte, 1954 L.K. Henry and W.E. Buker s.n.

Viola bicolor Pursh, 1950 L.K. Henry and F.H. Beer s.n.

Viola ×bissellii House, 1955 L.K. Henry s.n.

Viola blanda Willd. var. *blanda,* 2006 L. Speedy LS-06-132

Viola ×brauniae Grover ex Cooperrider, 1920 O.E. Jennings s.n.

Viola canadensis L. var. *canadensis,* 2006 L. Speedy LS-06-193

Viola cucullata Ait., 2006 L. Speedy LS-06-135

Viola ×eclipes H.E. Ballard, 1942 O.E. Jennings s.n.

Viola hastata Michx., 2006 L. Speedy LS-06-131

Viola hirsutula Brainerd, 1947 W.E. Buker s.n.

Viola labradorica Schrank, 2006 L. Speedy LS-06-157
Viola lanceolata L. ssp. *lanceolata,* 1988 R.S. Mulvihill and R.C. Leberman 10
Viola macloskeyi Lloyd ssp. *pallens* (Banks ex Ging) M.S. Baker, 2006 L. Speedy LS-06-167
Viola ×*malteana* House, 1961 L.K. Henry s.n.
Viola ×*palmata* L. (pro sp.), 1992 J.A. Isaac 3908
Viola ×*porteriana* Pollard (pro sp.), 1950 L.K. Henry and W.E. Buker s.n.
Viola ×*primulifolia* L. (pro sp.), 2007 L. Speedy and Botanical Soc. of W Pa 07-648
Viola pubescens Ait. var. *pubescens,* 2006 L. Speedy and D. Sofran LS-06-215
Viola pubescens Ait. var. *scabriuscula* Schwein. ex Torr. & Gray, 2006 L. Speedy LS-06-23
Viola ×*redacta* House, 1953 L.K. Henry and W.E. Buker s.n.
Viola rostrata Pursh, 2006 L. Speedy LS-06-70
Viola rotundifolia Michx., 2006 L. Speedy LS-06-94
Viola sagittata Ait. var. *ovata* (Nutt.) Torr. & Gray, 2006 L. Speedy LS-06-208
Viola sagittata Ait. var. *sagittata,* 1956 W.E. Buker s.n.
Viola sororia Willd., 2006 L. Speedy LS-06-42
Viola striata Ait., 2006 L. Speedy LS-06-178
Viola tripartita Ell., 1920 O.E. Jennings and G.K. Jennings and et. al. s.n. **G5:SH**

Vitaceae
Parthenocissus quinquefolia (L.) Planch., 2007 L. Speedy 07-1063
Vitis aestivalis Michx. var. *bicolor* Deam, 2007 L. Speedy and M. Bowers 07-670
Vitis cinerea (Engelm.) Millard var. *baileyana* (Munson) Comeaux, 1934 E.H. Graham s.n. **G4G5TNR:SH**
Vitis labrusca L., 2006 L. Speedy and K. Jurkovic LS-06-466
Vitis ×*novae-angliae* Fern. (pro sp.), 1942 O.E. Jennings s.n. **G4G5Q:S1**
Vitis riparia Michx., 1942 O.E. Jennings s.n.
Vitis rupestris Scheele, 2001 S.P. Grund and L. Smith 2562 **G3:S1**
Vitis vulpina L., 2007 L. Speedy and M. Bowers 07-672

Xyridaceae
Xyris torta Sm., 2006 L. Speedy and T. Pearson and D. Bryant LS-06-780 **G5:S1**

GYMNOSPERMS

Cupressaceae
Thuja occidentalis L., 1985 S.A. Thompson and M. Stieber 2224

Pinaceae
Abies balsamea (L.) P. Mill., 1998 P. Ludrosky 20-11-98, CUP
Larix decidua P. Mill., 1999 S.P. Grund 2140 Europe
Pinus resinosa Ait., 1966 A. Conn s.n.
Pinus rigida P. Mill., 2006 L. Speedy LS06-449-1
Pinus strobus L., 2006 L. Speedy and J. Nusser LS06-578-1
Pinus sylvestris L., 1985 K. Peters 22-7E-86 Eurasia, CUP
Pinus virginiana P. Mill., 1941 O.E. Jennings s.n.
Tsuga canadensis (L.) Carr., 2006 L. Speedy LS-06-402

Taxaceae
Taxus canadensis Marsh., 1936 W. McLean s.n. **G5:S3S4**

LYCOPHYTES

Isoëtaceae
Isoëtes engelmannii A. Braun, 1933 W.R/ Van Dersal s.n.

Lycopodiaceae
Huperzia lucidula (Michx.) Trevisan, 2006 L. Speedy LS-06-993
Lycopodiella inundata (L.) Holub, 2006 L. Speedy and E. Richards LS-06-315
Lycopodium clavatum L., 2006 L. Speedy LS-06-414
Lycopodium dendroideum Michx., 1963 O.E. Jennings s.n.
Lycopodium digitatum Dill. ex A. Braun, 2006 L. Speedy and K. Jurkovic LS-06-460
Lycopodium hickeyi W.H. Wagner, Beitel & Moran, 2006 L. Speedy and K. Jurkovic LS-06-692
Lycopodium obscurum L., 2006 L. Speedy and K. Jurkovic. LS-06-462
Lycopodium tristachyum Pursh, 1946 H.N. Mozingo s.n.

Selaginellaceae
Selaginella apoda (L.) Spring, 1937 O.E. Jennings s.n.

EQUISETOPHYTES

Equisetaceae
Equisetum arvense L., 2006 L. Speedy LS-06-64
Equisetum hyemale L. var. *affine* (Engelm.) A.A. Eat., 2007 L. Speedy 07-1724

POLYPODIOPHYTES

Aspleniaceae
Asplenium montanum Willd., 1995 S.P. Grund 1024
Asplenium pinnatifidum Nutt., 1995 S.P. Grund 1025 **G4:S3**
Asplenium platyneuron (L.) B.S.P. var. *platyneuron,* 2006 L. Speedy LS-06-942
Asplenium rhizophyllum L., 2006 L. Speedy LS-06-991
Asplenium ruta-muraria L. var. *cryptolepis* (Fern.) Wherry, 1934 E.H. Graham s.n.
Asplenium trichomanes L. ssp. *trichomanes,* 1948 D.H. Krouse s.n.
Asplenium ×*trudellii* Wherry (pro sp.), 1999 S.P. Grund and et al. 2272

Dennstaedtiaceae
Dennstaedtia punctilobula (Michx.) T. Moore, 2007 L. Speedy 07-1081
Pteridium aquilinum (L.) Kuhn. var. *latiusculum* (Desv.) Underwood ex Heller, 2006 L. Speedy LS-06-556

Dryopteridaceae
Athyrium filix-femina (L.) Roth ssp. *angustum* (Willd.) Clausen, 2006 L. Speedy LS-06-1005
Athyrium filix-femina (L.) Roth ssp. *asplenioides* (Michx.) Hulten, 1957 L.K. Henry s.n.
Cystopteris bulbifera (L.) Bernh., 1992 J.A. Isaac 3918
Cystopteris protrusa (Weatherby) Blasdell, 2007 L. Speedy and J. Nusser 07-604

Cystopteris tenuis (Michx.) Desv., 2006 L. Speedy LS-06-992
Deparia acrostichoides (Sw.) M. Kato, 2006 L. Speedy LS-06-999
Diplazium pycnocarpon (Spreng.) Broun, 2006 L. Speedy and J. Nusser LS-06-668
Dryopteris carthusiana (Vill.) H.P. Fuchs, 2006 L. Speedy LS-06-941
Dryopteris cristata (L.) Gray, 2007 L. Speedy 07-1658
Dryopteris goldiana (Hook. ex Goldie) Gray, 2006 L. Speedy and J. Nusser LS-06-669
Dryopteris intermedia (Muhl. ex Willd.) Gray, 2007 L. Speedy 07-621
Dryopteris marginalis (L.) Gray, 1999 R.B. Coxe s.n.
Dryopteris x*triploidea* Wherry, 2006 L. Speedy LS06-9401
Gymnocarpium dryopteris (L.) Newman, 1951 L.K. Henry and W.E. Buker s.n.
Matteuccia struthiopteris (L.) Todaro, 2006 L. Speedy LS-06-362
Onoclea sensibilis L., 1999 R.B. Coxe s.n.
Polystichum acrostichoides (Michx.) Schott var. *acrostichoides,* 1995 B.L. Isaac and J.A. Isaac 7084
Woodsia obtusa (Spreng.) Torr. ssp. *obtusa,* 1950 L.K. Henry and W.E. Buker s.n.

Ophioglossaceae

Botrychium dissectum Spreng., 2006 L. Speedy LS-06-972
Botrychium lanceolatum (Gmel.) Angstr. var. *angustistegmentum* Pease & Moore, 2003 E.A. Zimmerman 38
Botrychium matricarifolium (A.Braun ex Dowell) A. Braun ex Koch, 1949 W.E. Buker s.n.
Botrychium virginianum (L.) Sw., 2007 L. Speedy and J. Nusser 07-598
Ophioglossum vulgatum L., 2004 J. Love s.n. **G5:S3S4**

Osmundaceae

Osmunda cinnamomea L. var. *cinnamomea,* 2006 L. Speedy and M. Bowers LS-06-274
Osmunda claytoniana L., 2006 L. Speedy and M. Bowers LS-06-275
Osmunda regalis L. var. *spectabilis* (Willd.) Gray, 2007 L. Speedy and Botanical Soc. of W Pa 07-636

Polypodiaceae

Polypodium appalachianum Haufler & Windham, 2006 L. Speedy and J. Nusser LS-06-660
Polypodium virginianum L., 2006 L. Speedy LS-06-365

Pteridaceae

Adiantum pedatum L., 2007 L. Speedy LS-07-410
Pellaea atropurpurea (L.) Link, 1994 J.A. Isaac 6070

Thelypteridaceae

Phegopteris connectilis (Michx.) Watt, 1965 L. Louden s.n.
Phegopteris hexagonoptera (Michx.) Fee, 2006 L. Speedy LS-06-1002
Thelypteris noveboracensis (L.) Nieuwl., 2007 L. Speedy 07-614
Thelypteris palustris Schott var. *pubescens,* 2007 L. Speedy and M. Bowers 07-846

ACKNOWLEDGMENTS

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RARE AND ENDEMIC PLANTS OF THE BIG THICKET: A PHYTOGEOGRAPHICAL ANALYSIS

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ABSTRACT

The Big Thicket of southeastern Texas ranks relatively high with respect to species richness of rare Texas plants and near the top for West Gulf Coastal Plain endemics. Xeric sandylands, bogs, wetland pine savannas, prairies, and barrens support most of these species.

RESUMEN

El Big Thicket del sureste de Texas se sitúa relativamente alto con respecto a la riqueza de especies de plantas raras de Texas, y cerca del máximo para los endemismos de la West Gulf Coastal Plain. Los arenales xéricos, pantanos, sabanas húmedas de pino, praderas, y lugares vacíos es donde están la mayoría de estas especies.

INTRODUCTION

As part of a continuing study of the biogeography of the Big Thicket region of southeastern Texas (Brown et al. 2002, 2005, 2006a, 2006b, 2008; MacRoberts & MacRoberts 2004, 2007, 2008; MacRoberts et al. 2002c, 2007, in prep) in this paper we investigate Big Thicket rare and endemic plants.

METHODS

Using the Carr (2005) and Poole et al. (2007) annotated lists of rare Texas species and several sources for state distribution (e.g., Turner et al. 2003; Carr 2005; Diggs et al. 2006; Poole et al. 2007), we mapped rare species richness (defined as being the number of rare taxa per county) across Texas. The Carr (2005) sample consists of 450 species and includes all G3/T3 and rarer taxa. We modified the Poole et al. (2007) list to include only G2G3/T2T3 and rarer species, making that sample consist of 201 taxa. G and T ranks are discussed in Poole et al. (2007). Using Kartesz and Meacham (2005) and the *Flora of North America* (1993–2006), we mapped Big Thicket rare species across North America.

Using the MacRoberts et al. (2002b) list of West Gulf Coastal Plain endemics and a grid of 17 quadrats of equal size measuring about 130 km on a side and data on plant distribution from Thomas and Allen (1993–1998), Turner et al. (2003), and Diggs et al. (2006), we plotted endemic plant richness in the West Gulf Coastal Plain.

We define the Big Thicket region as Newton, Jasper, Tyler, Hardin, Polk, San Jacinto, and northern Liberty counties. A map showing the area constituting the West Gulf Coastal Plain is in MacRoberts et al. (2002b, 2007) and Diggs et al. (2006).

RESULTS

Figure 1 shows the distribution of rare Texas species by county for the Carr (2005) list. Figure 2 shows the distribution of rare Texas species by county for the modified Poole et al. (2007) list. In the Carr (2005) list, the Big Thicket region has 31 rare species. The modified Poole et al. (2007) list has 10 rare species. Figure 3 shows the distribution of West Gulf Coastal Plain endemic species by region. The Big Thicket has 69 West Gulf Coastal Plain plant endemics.

J. Bot. Res. Inst. Texas 2(2): 1475 – 1479. 2008

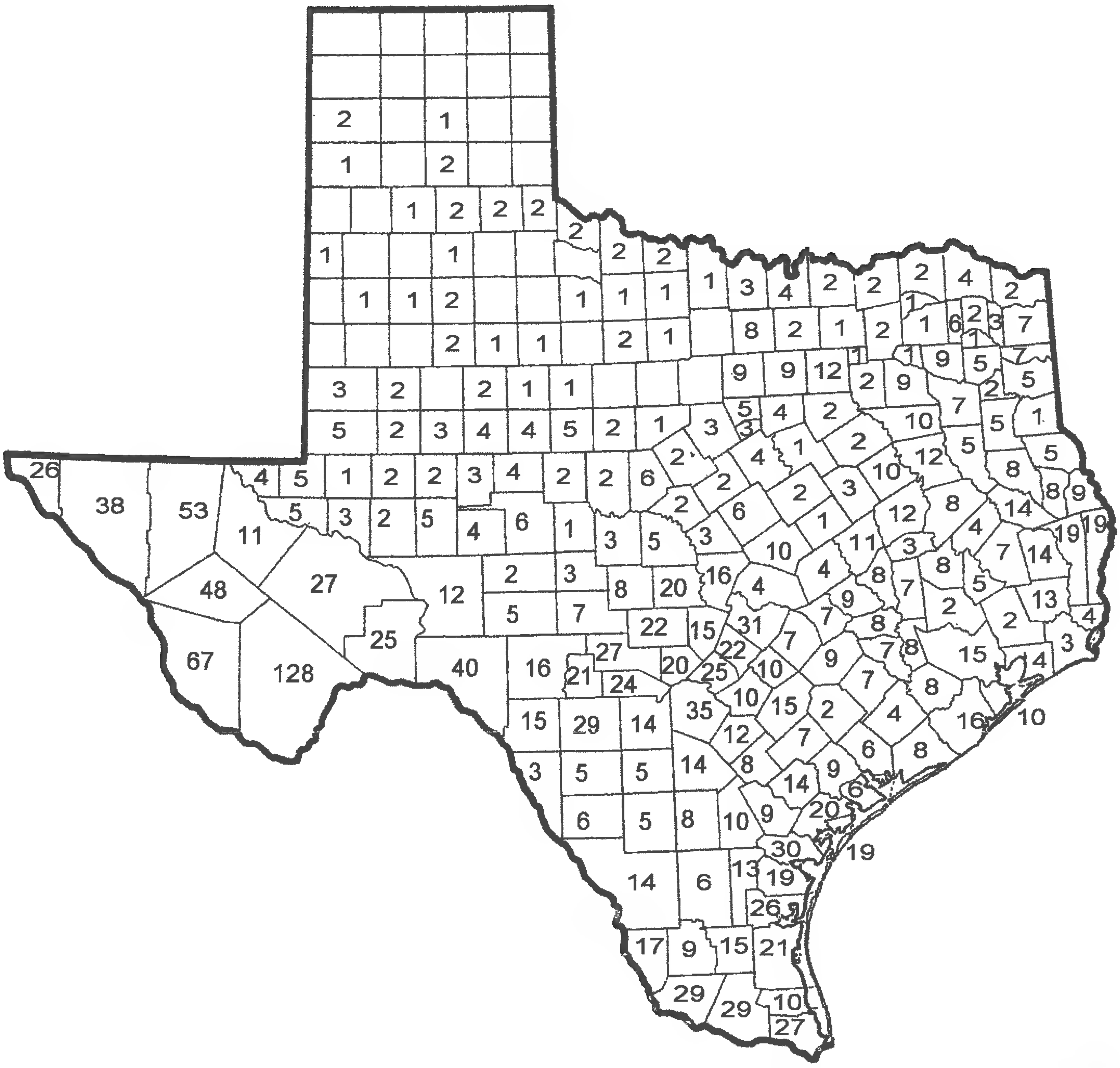
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Fig. 1. Distribution of rare Texas plants by county using the Carr (2005) list. The lack of a number indicates an absence of rare species.

DISCUSSION

In the Carr (2005) list, the Trans-Pecos region has by far the greatest number of rare species in the state, followed by the eastern part of the Edwards Plateau, the Coastal-Bend, and southern Texas (see also Diamond et al. 1997; Dobson et al. 1997). The Pineywoods region and specifically the eastern edge of the Big Thicket (Newton and Jasper counties) follows these areas. None of the Big Thicket region rare species is western. In the Carr (2005) list, all Big Thicket rare plants are either eastern, notably southeastern, (45%) (e.g., *Platanthera chapmanii, Agrimonia incisa, Rhynchospora macra, Xyris scabrifolia*), or West Gulf Coastal Plain endemics (55%) (e.g., *Bartonia texana, Rudbeckia scabrifolia, Trillium pusillum* var. *texanum, Yucca cernua*). The communities in which Big Thicket region rare species occur are xeric sandylands (26%), bogs/wetland pine savannas (26%), upland pineland (13%), barrens (13%), and baygalls (10%). The remaining 12% are divided among mixed hardwood forest, swamp, and bottomland hardwood forest.

In the modified Poole et al. (2007) list, the same pattern occurs as in the Carr (2005) list except it is less extreme. Nine of the Big Thicket rare species in this list are endemic to the West Gulf Coastal Plain

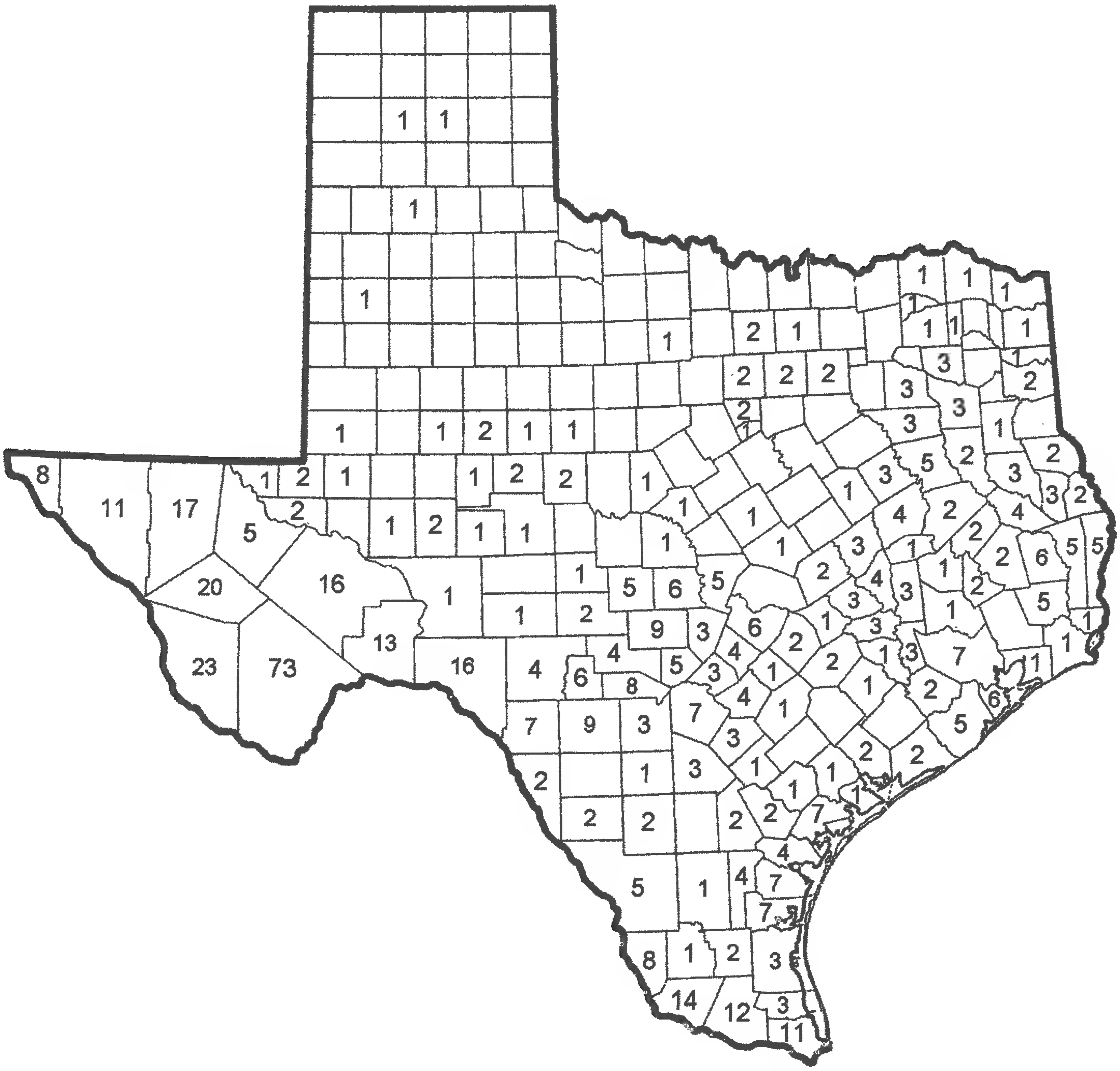
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Fig. 2. Distribution of rare Texas plants by county using the modified Poole et al. (2007) list. The lack of a number indicates an absence of rare species.

and one is southeastern. In this list, rare Big Thicket species occur in baygalls, bogs, prairies, barrens, dry uplands, and xeric sandylands.

The Big Thicket region is rich in West Gulf Coastal Plain endemics. It is second only to the region just to its west centered on Montgomery, Walker, Houston, Leon, Madison, Grimes, Brazos, and Robertson counties. The reason for this high incidence of West Gulf Coastal Plain endemics in the Big Thicket region is the presence of xeric sandylands (MacRoberts et al. 2002a; MacRoberts & MacRoberts 2006; Diggs et al. 2006), notably at the Roy Larsen Sandylands Sanctuary (Matos & Rudolph 1985). Xeric sandylands account for about 50% of West Gulf Coastal Plain endemics (MacRoberts et al. 2002b; MacRoberts & MacRoberts 2006) and about 59% of those in the Big Thicket region. Most of the remainder of the Big Thicket region endemics (29%) are in bogs, wetland pine savannas, barrens, baygalls, and prairies. The higher frequency of West Gulf Coastal Plain endemics just west of the Big Thicket is due to its slightly higher incidence of xeric sandyland endemics combined with prairie, bog, and barren endemics.

The Big Thicket, therefore, fares well in Texas and the West Gulf Coastal Plain with respect to rare and endemic species. It ranks in the top half for richness of rare Texas species and near the top for West Gulf

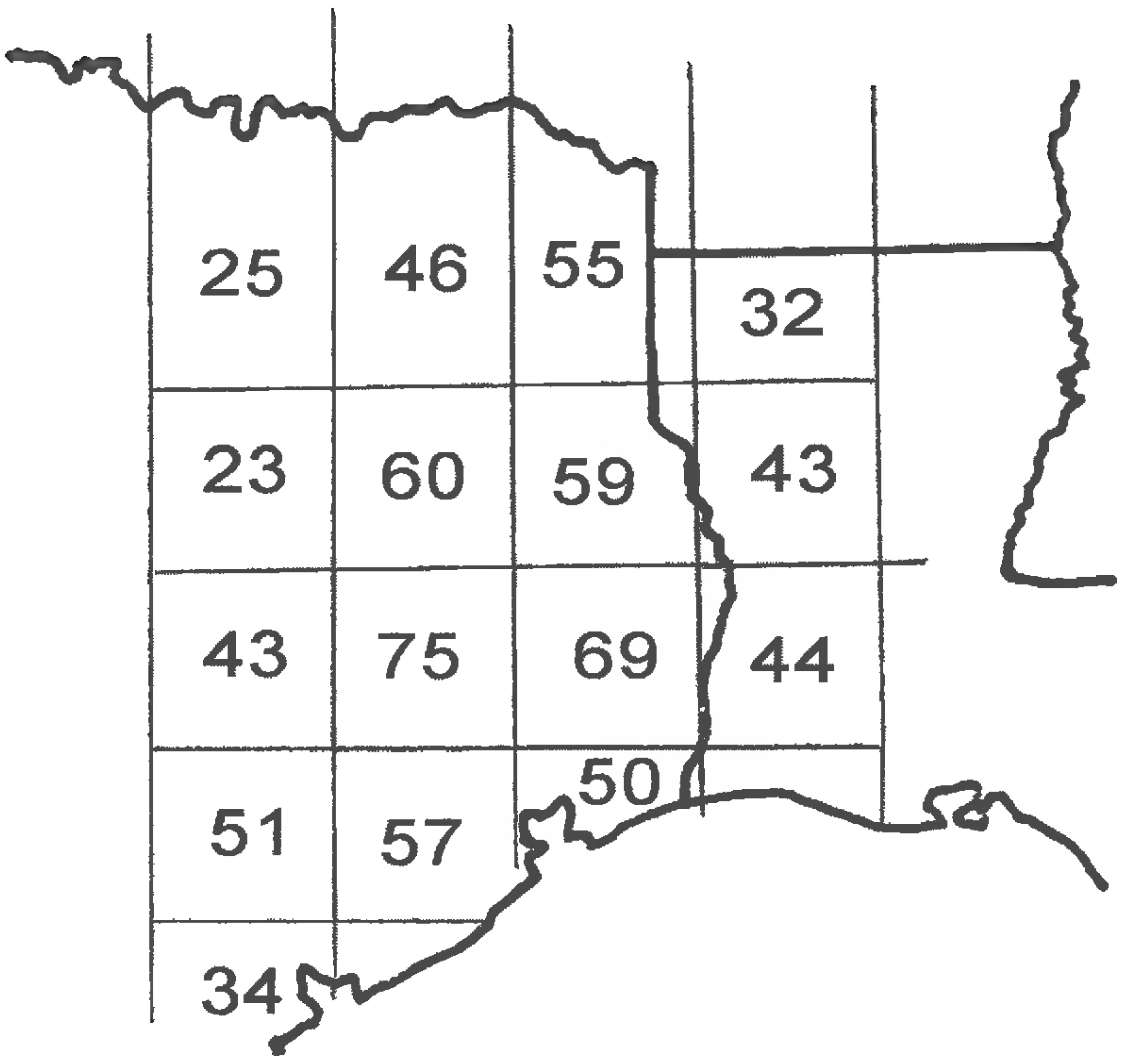

Fig. 3. West Gulf Coastal Plain endemics by quadrat.

Coastal Plain endemics, pinpointing important habitat for conservation, notably xeric sandylands, bogs, wetland pine savannas, prairies, and barrens. Since rare and endemic plant lists are subject to change because of taxonomic research, distributional discoveries, and other factors, these results are, of course, tentative and future lists will undoubtedly provide changes in the results presented here.

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BOOK NOTICE

ZHENBIAO YANG (ED.). 2008. **Annual Plant Reviews, Volume 33: Intracellular Signaling in Plants.** (ISBN-13: 978-1-4051-6002-5, 10: 1-4051-6005-0, hbk.). Wiley-Blackwell Publishing, 2121 State Avenue, Ames, Iowa 50014-8300, U.S.A. (**Orders:** www.blackwellpublishing.com, orders@ames.blackwellpublishing.com, 800-862-6657). $224.99, 430 pp., 48 illustrations, 9" × 6".

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12. Signaling by Protein Phosphorylation in Cell Division—*Mitchiko Sasabe and Yasunori Machida*
13. Guard Signaling—*Yan Wu*
14. The Molecular Networks of Abiotic Stress Signaling—*Zhizhong Gong, Viswanathan Chinnusamy, and Jian-Kang Zhu*

Index

ANNOTATED CHECKLIST OF THE VASCULAR FLORA OF THE LOBLOLLY UNIT OF THE BIG THICKET NATIONAL PRESERVE, LIBERTY COUNTY, TEXAS

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ABSTRACT

An annotated, vouchered checklist is provided of the vascular plant taxa of the 222 hectare Loblolly Unit of the Big Thicket National Preserve in Liberty County, Texas. Documented for the unit are 305 taxa including 34 (11%) exotics

RESUMEN

Se aporta un catálogo comentado y respaldado con testigos de los taxa de plantas vasculares de las 222 hectáreas de la unidad Loblolly de la Reserva Big Thicket National en el condado de Liberty, Texas. Se documentan para la unidad 305 taxa incluyendo 34 (11%) exóticas.

INTRODUCTION

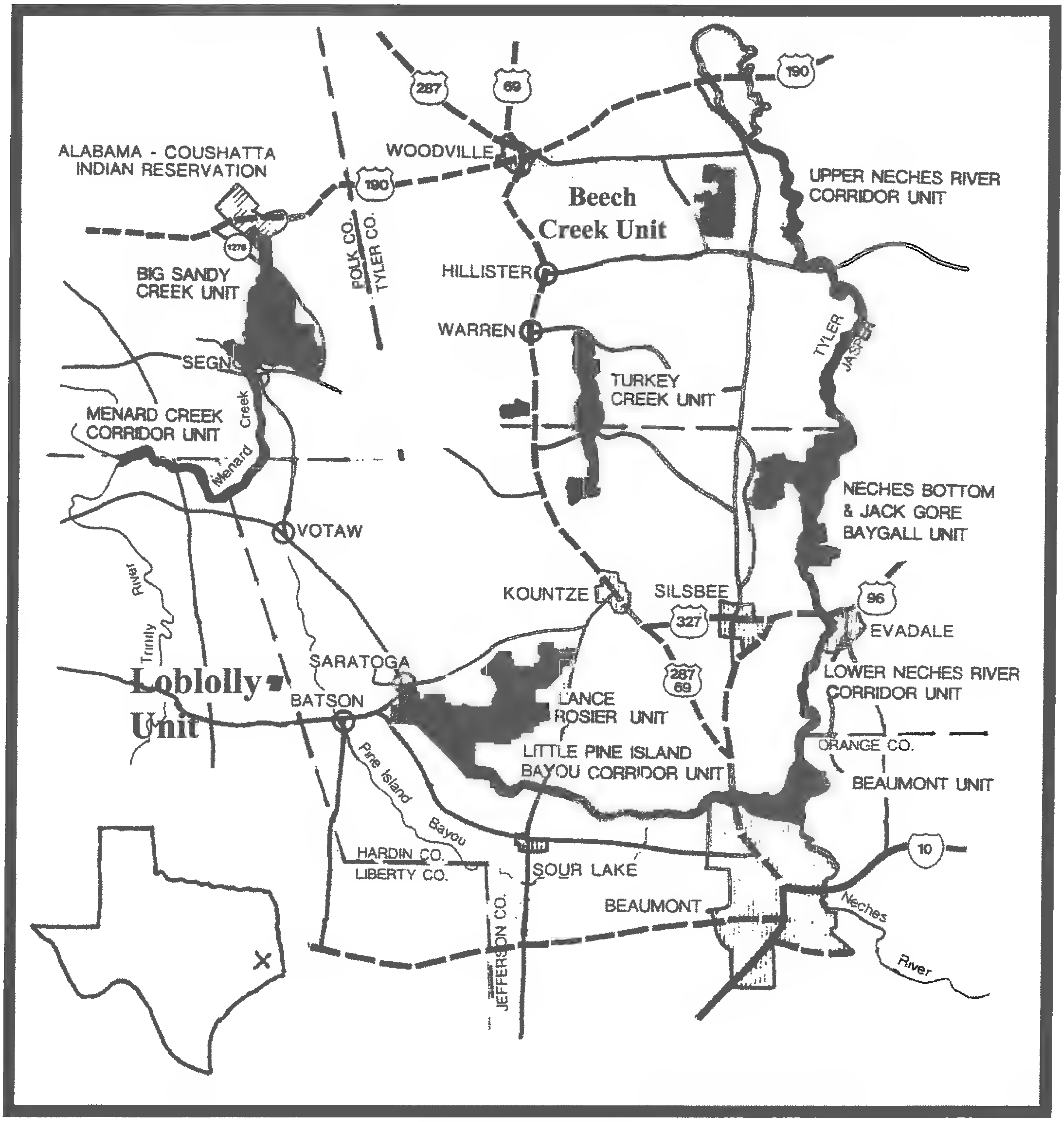
This paper is the 6th part of an inventory, based on available voucher specimens, of the vascular flora of the Big Thicket National Preserve in southeastern Texas. In 5 previous papers, we provided annotated checklists of the Hickory Creek, Turkey Creek, Big Sandy Creek, Lance Rosier, and Beech Creek units (MacRoberts et al. 2002; Brown et al. 2005, 2006a, 2006b, 2008). At this time, the Menard Creek Unit has been inventoried, and a paper is anticipated in the near future. Here, we provide an annotated checklist of the Loblolly Unit.

SITE AND METHODS

The Big Thicket is located in the West Gulf Coastal Plain in southeastern Texas (see Diggs et al. 2006 for literature and description). Peacock (1994) reported 12 units for the Big Thicket National Preserve. Since then the Big Sandy Creek Corridor (1,798 hectares), the Canyonlands (350 hectares), and Village Creek Corridor (2,059 hectares) have been added. The addition of these 3 units has added 4,207 hectares to the 34,000 reported by Peacock in 1994. However, Deanna Boensch, Big Thicket fire ecologist (pers. comm.), indicated the total hectares are now 40,088. The units range from 222 to 10,000 hectares and are scattered over 7 Texas counties. The Loblolly Unit consists of 222 hectares in Liberty County (Fig. 1). It is located on the Beaumont formation on Aldine-Aris/Gyron-Aldine, Vamont, and Waller soils, and is topographically flat, and poorly drained with very slow permeability (Deshotels 1978; Aronow 1981; Shelby et al. 1992; Griffith 1996). Elevation is about 30 meters. After heavy rain falls, standing water is present in the flatwoods for extended periods of time. The Unit consists of basically 1 plant community complex: Floodplain and/or Flatland Hardwood Forest, a common association in the area (Ajilvsgi 1979; Marks & Harcombe 1981; Bezanson 2000).

It has been suggested that a century ago the Loblolly Unit was prairie; but, because of fire suppression and other human activities, it has become Flatland Hardwood Forest (Watson 1979; Peacock 1994; Diggs et

J. Bot. Res. Inst. Texas 2(2): 1481 – 1489. 2008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INDIAN RESERVATION
WOODVILLE
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UPPER NECHES RIVER
CORRIDOR UNIT
Beech
Creek Unit
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POLK CO.
TYLER CO.
BIG SANDY
CREEK UNIT
HILLISTER
WARREN
TYLER
JASPER
SEGNO
TURKEY
CREEK UNIT
MENARD CREEK
CORRIDOR UNIT
Menard
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NECHES BOTTOM
& JACK GORE
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Loblolly
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ROSIER UNIT
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CORRIDOR UNIT
LITTLE PINE ISLAND
BAYOU CORRIDOR UNIT
ORANGE CO.
BEAUMONT UNIT
Pine Island
Bayou
HARDIN CO.
LIBERTY CO.
SOUR LAKE
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BEAUMONT
Neches
River
JEFFERSON CO.

Fig. 1. Location of the Loblolly Unit, Big Thicket National Preserve, Texas.

al. 2006). However, others have questioned this interpretation maintaining that it has always been Flatland Hardwood Forest although it may have been cleared in the past (Harcombe & Marks 1979). Our study of the Loblolly Unit found no prairie species or any remnant prairie habitat. Therefore, the flora is clearly a Flatland Hardwood Forest (Harcombe & Marks 1979; Marks & Harcombe 1981).

Like all units of the Big Thicket National Preserve, the Loblolly Unit has not previously been the subject of a detailed floristic inventory.

Because our purpose is to produce a list of taxa known to occur on the Loblolly Unit, a vouchered specimen was considered to be the only evidence acceptable for inclusion in the list. A total of 471 herbarium specimens form the data for this report. All specimens have been annotated by Larry Brown.

Larry Brown collected 277 specimens during 11 field days from 5 August 1978 to 14 June 2008. The

MacRoberts' collected 127 specimens during 5 field days from 30 July 2007 to 18 May 2008. Sandra Elsik and Warren Pruess collected 35 specimens during 2007. Susan Walker collected 23 specimens on 22 October 2007. Geraldine Watson collected 9 specimens over several years in the late 1970s and early 1980s.

In most cases, nomenclature follows Jones et al. (1997); Kartesz (1999); and Diggs et al. (2006). In cases of multiple collections, no more than 4 are listed for each taxon.

RESULTS

The following is an annotated list of the Loblolly Unit taxa. Abbreviations used are given below.

GW = Geraldine Watson. Her specimens are at TAES.
LB = Larry Brown. His specimens with collection numbers above 29,000 are at TAES and those few with numbers below 29,000 are at SBSC.
MM = Barbara and Michael MacRoberts. Their specimens are at TAES.
SEWP = Sandra Elsik and Warren Pruess. Their specimens are at TAES.
SH = Shawn Harper, grandson of LB.
SW = Susan Walker. Her specimens are at TAES.
* = exotic
+ = see note at end of list.

Acanthaceae
Hygrophila lacustris (Schlecht. & Cham.) Nees, LB 32266
Justicia ovata (Walter) Lindau var. *lanceolata* (Chapm.) R.W. Long, LB 32200, 29281, 29298; MM 7930
Ruellia caroliniensis (J.F. Gmel.) Steud., LB 29318; MM 8231; LBSH 33675

Aceraceae
Acer rubrum L., SEWP 3044; MM 7906, 8094

Amaryllidaceae
Hymenocallis liriosme (Raf.) Shinners, LBSH 33311

Anacardiaceae
Rhus copallinum L., LB 32264
Toxicodendron radicans (L.) Kuntze, LB 32254

Apiaceae
Centella erecta (L.f.) Fernald, MM 8012; LB 32315
Chaerophyllum tainturieri Hook. var. *dasycarpum* Hook. ex S. Watson, SEWP 3044
Chaerophyllum tainturieri Hook. var. *tainturieri*, LBSH 33302
**Cyclospermum leptophyllum* (Pers.) Sprague ex Britton & P. Wilson, LB 29314
Cynosciadium digitatum DC., LB 32202
Eryngium prostratum Nutt. ex DC., LB 32187
Hydrocotyle verticillata Thunb., LB 32193, 29323; MM 7918
Limnosciadium pumilum (Engelm. & A. Gray) Mathias & Constance, LBSH 33486
Ptilimnium capillaceum (Michx.) Raf., LB 32205
Sanicula canadensis L., LB 29289

Apocynaceae
Trachelospermum difforme (Walter) A. Gray, LB 32412

Aquifoliaceae
Ilex decidua Walter, LBSH 33298; SW 139
Ilex opaca Aiton, LB 32278
Ilex vomitoria Aiton, LB 32251

Araceae
Arisaema triphyllum (L.) Schott., MM 8004

Araliaceae
Aralia spinosa L., LB 32306; MM 7895

Arecaceae
Sabal minor (Jacq.) Pers., LB 32415

Aristolochiaceae
Aristolochia serpentaria L., MM 7990

Asclepiadaceae
Asclepias perennis Walter, LB 32211, 29285; MM 7923; SW 151

Asteraceae
Acmella oppositifolia (Lam.) Jansen, LB 32206; MM 7935
Ambrosia trifida L., LB 32431; MM 7975
Baccharis halimifolia L., MM 7998
Conoclinium coelestinum (L.) DC., LB 32269
Coreopsis tinctoria Nutt., LB 32261; MM 7926
Eclipta prostrata (L.) L., MM 7934, 8010; LB 5849
Elephantopus carolinianus Raeusch., LB 32425; MM 7968
Elephantopus tomentosus L., LB 32414; MM 8011
Erechtites hieraciifolia (L.) Raf., LB 32274, 32413; MM 8070
Erigeron philadelphicus L., SEWP 3034
Eupatorium capillifolium (Lam.) Small, MM 7999
+*Eupatorium semiserratum* DC., GW 2159
Eupatorium serotinum Michx., LB 32284
Euthamia leptocephala (Torr. & A. Gray) Greene ex Porter & Britton, LB 32290
Gamochaeta pensylvanicum (Willd.) Cabrera, SEWP 3030
Gamochaeta purpurea (L.) Cabrera, LBSH 33305, 33488
Helenium amarum (Raf.) Rock var. *amarum*, LB 32265; MM 7902
Krigia cespitosa (Raf.) K.L. Chambers var. *cespitosa*, LBSH 33292
Mikania scandens (L.) Willd., LBSH 33666

Pluchea camphorata (L.) DC., LB 32426; MM 8002
Pluchea foetida (L.) DC., MM 8006
Pyrrhopappus carolinianus (Walter) DC., LB 32436
Pyrrhopappus pauciflorus (D. Don) DC., LB 29309a
Solidago altissima L., MM 7976
Solidago rugosa Mill. var. *asper* (Aiton) Fernald, LB 32293; MM 8087
**Sonchus asper* (L.) Hill, LBSH 33309
**Sonchus oleraceus* L., MM 8232
Symphyotrichum lateriflorum (L.) Love & Love, MM 8099
Symphyotrichum racemosum (Elliott) Nesom, LB 32270
Vernonia missurica Raf., MM 7908
**Youngia japonica* (L.) DC., LBSH 33308

Berberidaceae
Podophyllum peltatum L., LBSH 33507

Betulaceae
Carpinus caroliniana Walter, SW 140
Ostrya virginiana (Mill.) K. Koch, LB 32424

Bignoniaceae
Bignonia capreolata L., LB 32252, 29317
Campsis radicans (L.) Seem. ex Bureau, LB 32443
Catalpa bignonioides Walter, LB 32442

Blechnaceae
Woodwardia areolata (L.) T. Moore, MM 7983; LBSH 33484

Boraginaceae
**Heliotropium indicum* L., MM 8100
Heliotropium procumbens Mill., LB 29312, 5852
Myosotis macrosperma Engelm., LBSH 33297

Brassicaceae
Rorippa sessiliflora (Nutt.) Hitchc., LBSH 33284

Bromeliaceae
Tillandsia usneoides (L.) L., SW 137

Buddlejaceae
Polypremum procumbens L., LB 32437

Campanulaceae
Lobelia cardinalis L., MM 8009; LB 14856

Caprifoliaceae
**Lonicera japonica* Thunb., SEWP 3028
Sambucus nigra L. subsp. *canadensis* (L.) Bollii, LB 32255; MM 7899
Viburnum dentatum L., LB 29305

Caryophyllaceae
**Cerastium glomeratum* Thrill., SEWP 3042
**Stellaria media* (L.) Vill., SEWP 3041

Commelinaceae
Commelina diffusa Burm f., MM 8077
Commelina virginica L., LB 32272; MM 7925

Convolvulaceae
Dichondra carolinensis Michx., SEWP 3027; MM 7896
Ipomoea cordatotriloba Dennst., MM 7904
Ipomoea lacunosa L., MM 8007

Cornaceae
Cornus florida L., SEWP 3005; SW 145; LBSH 33672
Cornus foemina Mill., LB 29320, 29304; SW 138
Nyssa biflora Walter, LB 32304; LBSH 33301
Nyssa sylvatica Marsh., LB 29306; MM 8085; LBSH 33506

Crassulaceae
Penthorum sedoides L., LB 32433, 14866; MM 7916

Cucurbitaceae
Cayaponia quinqueloba (Raf.) Shinners, SW 149

Cyperaceae
Carex abscondita Mack., LBSH 33504
Carex blanda Dewey, MM 8233
Carex complanata Torr. & Hook., LB 32248
Carex caroliniana Schwein., LBSH 33293
Carex cherokeensis Schwein., LBSH 33289
Carex crus-corvi Shutlew. ex Kunze, LB 32189; SEWP 3022
Carex debilis Michx., LB 32246
Carex flaccosperma Dewey, LBSH 33487
Carex frankii Kunth, LB 32191, 29319; MM 7927, 8230
Carex intumescens Rudge, LBSH 33485
Carex joori L H. Bailey, LB 32277, 3724; MM 7996
Carex louisianica Bailey, LB 29296, 29300, 32419; MM 7997
Carex reniformis (L.H. Bailey) Small, LBSH 33287
Carex triangularis Boeck., LBSH 33285, 33481; LB 29324
Carex tribuloides Wahlenb. var. *sangamonensis* Clokey, LB 32186, 32195; LBSH 33502, 33680
Cyperus acuminatus Torr. & Hook. ex Torr., LBSH 33492
**Cyperus entrerianus* Bockeler, LB 32242; LBSH 33479; SW 159
Cyperus erythrorhizos Muhl., MM 8005 b
Cyperus ochraceus Vahl, MM 7977
Cyperus pseudovegetus Steud., LB 32283, 32310
Cyperus virens Michx., LB 32247
Eleocharis engelmannii Steud., LBSH 33668
Eleocharis microcarpa Torr., MM 8022
Eleocharis montana (Kunth) Roem. & Schult., LB 32285
Eleocharis montevidensis Kunth, LB 32267; SEWP 3024
**Fimbristylis miliacea* (L.) Vahl, MM 8089
Isolepis carinata Hook. & Arn. ex Torr., LBSH 33299
+Kyllinga pumila Michx., LB 32258, 17501a; MM 7987, 8080
Rhynchospora caduca Elliott, LB 32286, 32307, 32196, 32192
Rhynchospora corniculata (Lam.) A. Gray; LB 32245; MM 7922
Rhynchospora glomerata (L.) Vahl, LB 32301, 32317; LBSH 33678
Rhynchospora inexpansa (Michx.) Vahl, LB 32201; LBSH 33674
Rhynchospora mixta Britton, LB 29295; LBSH 33480
Scirpus cyperinus L., LB 32212; SW 132
Scleria oligantha Michx., LB 32423
Scleria triglomerata Michx., LB 29286

Dennstaedtiaceae
Pteridium aquilinum (L.) Kuhn var. *pseudocaudatum* (Clute) A. Heller, LB 32416

Dryopteridaceae
Onoclea sensibilis L., LB 32289, 29288; MM 7984
Polystichum acrostichoides (Michx.) Schott, MM 8095; LBSH 33505

Ebenaceae
Diospyros virginiana L., LB 29284

Ericaceae
Vaccinium arboreum Marshall, LB 29294

Euphorbiaceae
Acalypha gracilens A. Gray, LB 32308
Phyllanthus caroliniensis Walter, LB 32411, 33132
**Phyllanthus urinaria* L., MM 7917
**Triadica sebiferum* (L.) Small, LB 32268; MM 7905

Fabaceae
**Albizia julibrissin* Durazz., MM 8109
Centrosema virginianum (L.) Benth., GW 2156
Desmodium glabellum (Michx.) DC., GW 2157; MM 7992; LBSH 33494
**Medicago lupulina* L., MM 8228
**Trifolium campestre* Schreb., LBSH 33291
**Trifolium repens* L., LBSH 33283
Vicia ludoviciana Nutt. subsp. *ludoviciana*, LBSH 33290

Fagaceae
Quercus alba L., MM 8101
Quercus falcata Michx., MM 8103, 8093
Quercus laurifolia Michx., LB 32275a
Quercus michauxii Nutt., LB 29283; MM 7911
Quercus nigra L., MM 8084, 8092; LB 32275
Quercus phellos L., LB 32250, 29290
Quercus shumardii Buckley, SW 135
+*Quercus velutina* Lam., MM 8083, 8090; SW 144, 141; LBSH 33677

Gentianaceae
**Centaurium pulchellum* (Sw.) Druce, MM 8229

Geraniaceae
Geranium carolinianum L., SEWP 3045

Haloragaceae
Proserpinaca palustris L. var. *crebra* Fernald & Griscom, LB 32276; LBSH 33671

Hammamelidaceae
Liquidambar styraciflua L., LB 29291

Hydrophyllaceae
Hydrolea uniflora Raf., SW 153

Hypericaceae
Hypericum hypericoides (L.) Crantz, LB 29315; MM 7915
Hypericum mutilum L., LB 32299; MM 8087
Triadenum walteri (J. G. Gmel.) Gleason, LB 29293; MM 7978

Hypoxidaceae
Hypoxis curtissii Rose, MM 8237
Hypoxis wrightii (Baker) Brackett, LBSH 33287

Iridaceae
Sisyrinchium rosulatum E.P. Bicknell, LB 29311; SEWP 3026; MM 8236

Juglandaceae
Carya aquatica (Michx. f.) Nutt., SW 136
Carya glabra (Mill.) Sweet, LB 32292; MM 8087; LBSH 33496; SW 134

Juncaceae
Juncus acuminatus Michx., LB 32313
Juncus coriaceus Mack., LB 32243; SEWP 3043
Juncus dichotomus Elliott, LB 32267a
Juncus diffusissimus Buckley, LBSH 33490
Juncus effusus L., LB 31938; SEWP 3025
Juncus tenuis Willd., LBSH 33493
Juncus validus Coville, LB 32244

Lamiaceae
Hedeoma hispida Pursh, LBSH 33495
Hyptis alata (Raf.) Shinners, MM 8003
Lycopus rubellus Moench., MM 8000
Lycopus virginicus L., GW 2086; MM 8072
Micromeria brownei (Sw.) Benth. var. *pilosiuscula* A. Gray, LB32207; SEWP 3037
Prunella vulgaris L., LB 29308
Salvia lyrata L., SEWP 3040
Scutellaria integrifolia L., LB 32287
Stachys tenuifolia Willd., LB 32190, 32260; MM 7921; LBSH 33669

Lauraceae
Sassafras albidum (Nutt.) Nees, SEWP 3014; MM 7901, 7993

Liliaceae
Nothoscordum bivalve (L.) Britton, SEWP 3010

Linaceae
Linum striatum Walter, LB 32439

Loganiaceae
Gelsemium sempervirens (L.) Aiton f., SEWP 3015
Mitreola petiolata (J. F. Gmel.) Torr. & A. Gray, LB 32188; MM 7931; SW 155

Lygodiaceae
**Lygodium japonicum* (Thunb. ex Murray) Sw., LB 29316; SEWP 3016; MM 7909

Lythraceae
**Cuphea carthagenensis* (Jacq.) J. F. Macbr., LB 32305, 5593; MM 7928

Magnoliaceae
Magnolia grandiflora L., SW 146

Malvaceae
Modiola caroliniana (L.) G. Don, SEWP 3038
Sida rhombifolia L., LB 32294; MM 7970

Melastomataceae
Rhexia mariana L. var. *mariana*, LB 32295

Moraceae
Morus rubra L., MM 7903

Myricaceae
Morella cerifera (L.) Small, SEWP 3011

Oleaceae
Chionanthus virginicus L., MM 8086
Fraxinus americana L., LB 29303
Fraxinus pennsylvanica Marsh., LB 32309, 32432; MM 8107; SW 156

Onagraceae
Ludwigia decurrens Walter, MM 8001
Ludwigia glandulosa Walter, LB 32210
Ludwigia hirtella Raf., LB 32438
Ludwigia octovalvis (Jacq.) P. H. Raven; MM 7933, 7979
Ludwigia palustris (L.) Elliott, LB 32194
Ludwigia sphaerocarpon Elliott, GW 2399
Oenothera speciosa Nutt., SEWP 3035

Ophioglossaceae
Botrychium biternatum (Savogny) Underwood, MM 7995, 8104

Oxalidaceae
Oxalis corniculata L. var. *wrightii* (A. Gray) B.L. Turner, SEWP 3031; LBSH 33304

Passifloraceae
Passiflora incarnata L., LB 32298; MM 8098
Passiflora lutea L., LB 32253

Pinaceae
Pinus taeda L., LB 32291, 32319

Plantaginaceae
*_Plantago major_ L., LB 32184; MM 7973, 8234
Plantago rhodosperma Decne., LBSH 33310
Plantago virginica L., MM 8238

Platanaceae
Platanus occidentalis L., LB 32420; SW 133

Poaceae
Agrostis hyemalis (Walter) Britton, Sterns & Poggenb., LBSH 33499
Axonopus fissifolius (Raddi) Kuhlmann, LB 32314, 32303a; GW 2177
Axonopus furcatus (Flugge) A. S. Hitchc., LB 32427
*_Briza minor_ L., LBSH 33288
*_Bromus japonicus_ Thunb. ex Murray, LB 32181
Chasmanthium laxum (L.) H.O. Yates, GW 2314
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark var. *acuminatum*, LB 29301a, 32320
Dichanthelium acuminatum (Sw.) Gould & C.A. Clark var. *lindheimeri* (Nash) Gould & C.A. Clark, LBSH 33489
Dichanthelium commutatum (Schult.) Gould subsp. *commutatum*, LB 29287, 32422; LBSH 33679
Dichanthelium dichotomum (L.) Gould subsp. *dichotomum*, LB 29301; MM 7988
Dichanthelium dichotomum (L.) Gould subsp. *microcarpon* (Muhl. ex Elliott) Freckmann & Lelong, LB 32197, 32257, 32323; LBSH 33478
Dichanthelium laxiflorum (Lam.) Gould, LB 32435
Dichanthelium ovale (Elliott) Gould & C.A. Clark subsp. *villosissimum* (Nash) Freckmann & Lelong, LB 32321
Dichanthelium sphaerocarpon (Elliott) Gould , SEWP 3020; LBSH 33491
Digitaria ciliaris (Retz) Koeler, LB 32297
+*_Echinochloa colonum_ (L.) Link, MM 7980
*_Eleusine indica_ (L.) Gaertn., MM 8067
Elymus virginicus L., LB 32203; MM 8227
Eragrostis hypnoides (Lam.) Britton, Sterns & Poggenb., GW 2168
Leersia lenticularis Michx., GW 2162; LB 32204; SW 158
Leersia virginica Willd., LB 32208
Oplismenus hirtellus (L.) P. Beauv. subsp. *setarius* (Lam.) Mez ex Ekman, GW 2313; MM 8067; LBSH 33670
Panicum anceps Michx., LB 32300, 32318
Panicum dichotomiflorum Michx., MM 8076
Panicum gymnocarpon Elliott, LB 5595, 32428; MM 7925
Panicum rigidulum Nees, LBSH 33503
*_Paspalum dilatatum_ Poir., LB 32409; MM 7974
+*Paspalum conjugatum* P.J. Bergius, LB 32303
Paspalum laeve Michx. var. *laeve*, LB 32440
Paspalum notatum Flugge, LB 32273
Paspalum praecox Walter, LB 32302
Paspalum repens P.J. Bergius, LB 17502
Paspalum setaceum Michx., LB 32312
*_Paspalum urvillei_ Steud., LBSH 33497
Phalaris angusta Nees ex Trin., LBSH 33498; MM 8235
Phalaris caroliniana Walter, LBSH 33482
*_Poa annua_ L., LBSH 33294
Saccharum giganteum (Walter) Pers., SW 147
*_Sacciolepis indica_ (L.) Chase, GW 2324
Setaria parviflora (Poir.) Kerguelen, LB 32209
Sphenopholis obtusata (Michx.) Scribn., LBSH 33500

Polygonaceae
Polygonum densiflorum Meisn., MM 8102
Polygonum hydropiperoides Michx., LB 32198, 29302; SEWP 3032; MM 8008

Polypodiaceae
Pleopeltis polypodioides (L.) E.B. Andrews & Windham subsp. *michauxiana* (Weatherby) E.B. Andrews & Windham, MM 8091

Primulaceae
*_Anagallis arvensis_ L., LB 29322; SEWP 3036
Samolus valerandi L. subsp. *parviflorus* (Raf.) Hulten, LB 29313, 32182; SEWP 3018; MM 7920

Ranunculaceae
*_Ranunculus muricatus_ L., SEWP 3047

Rhamnaceae
Berchemia scandens (Hill) K. Koch, LB 29321, 32322; SEWP 3021

Rosaceae
Crataegus marshallii Eggl., MM 8097
Crataegus opaca Hook. & Arn. ex Hook., LB 32282, 29284a, 29307
*_Duchesnea indica_ (Andr.) Focke, SEWP 3033; SW 154
Prunus serotina Ehrh. var *serotina*, SEWP 3012; LBSH 33483
Rubus argutus Link, LB 32280, SEWP 3023, 3007; MM 7986

Rubiaceae
Cephalanthus occidentalis L., LB 32429; MM 7914

Diodia virginiana L., LB 32259; MM 7912
**Galium aparine* L., SEWP 3046
Galium tinctorium L., LBSH 33304, 33306
Houstonia pusilla Schoepf., LBSH 33283a
Mitchella repens L., LB 29310

Saururaceae
Saururus cernuus L., LB 29283a; MM 7913

Scrophulariaceae
Bacopa monnieri (L.) Penn., LB 32262; MM 8088
Gratiola virginiana L., LB 31938; SEWP 3002
Leucospora multifida (Michx.) Nutt., LB 29309
**Lindernia crustacea* (L.) F. von Muell., LB 32410; MM 7969, 8081; SW 157
Lindernia dubia (L.) Penn., LB 32288
Mecardonia acuminata (Walter) Small, MM 7972
Mecardonia procumbens (Mill.) Small, SEWP 3029; MM 7919, 7971
Micranthemum umbrosum (J.F. Gmel.) S.F. Blake, MM 8106
Mimulus alatus Aiton, MM 7932; SW 143
Scoparia dulcis L., LB 32296; MM 7897
Veronica peregrina L.var. *peregrina*, LBSH 33305a

Smilacaceae
Smilax bona-nox L., MM 7989; LB 32316
Smilax glauca Walter, MM 8096
Smilax rotundifolia L., SEWP 3008; LB 29297; MM 7985
Smilax smallii Morong, SEWP 3006

Solanaceae
Physalis cinerascens (Dunal) A.S. Hitchcock var. *cinerascens*, LB 29310a
Solanum carolinense L., LB 32256; MM 7910

Styracaceae
Styrax americana Lam., LB 32279

Symplocaceae
Symplocos tinctoria (L.) L. Her., LB 29282; LBSH 33300; SW 148

Thelypteridaceae
Thelypteris kunthii (Desv.) Morton, LB 29281a, 32185; MM 7991

Ulmaceae
Ulmus americana L., LB 32249; SEWP 3001; SW 150; LBSH 33676

Urticaceae
Boehmeria cylindrica (L.) Sw., LB 5595; MM 7894

Valerianaceae
Valerianella radiata (L.) Dufr., LBSH 33286

Verbenaceae
Callicarpa americana L., LB 32281; MM 7898
Phyla nodiflora (L.) Greene, MM 7929
**Verbena brasiliensis* Vell., LBSH 33667
Verbena scabra Vahl, MM 7981
Verbena urticifolia L., LB 32183

Violaceae
Viola lanceolata L., LBSH 33296
Viola sororia Willd. var. *missouriensis* (Green) McKinney, SEWP 3009

Vitaceae
Ampelopsis arborea (L.) Koehne, LB 32271
Parthenocissus quinquefolia (L.) Planch., LB 32311; MM 8079
Vitis aestivalis Michx., SW 142; MM 8232
Vitis cinerea (Engelm.) Engelm. ex Millardet var. *cinerea*, LB 29299, 32418
Vitis rotundifolium Michx., LB 32263; MM 7893

Xyridaceae
Xyris ambigua Bey. ex Kunth, GW 2224; LB 32436

NOTES

Eupatorium semiserratum. This species is usually found in low moist areas which are frequent in this Unit. See Brown et al.(2007) for a discussion of this species in Texas.

Kyllinga pumila. *Kyllinga odorata* is the most common *Kyllinga* in the Houston area (Harris and surrounding counties) but not present in this Unit. *K. pumila* is rare in the Houston area but common along C.R. 2071 that extends through the center of the Unit.

Quercus velutina. This woody plant, as of now, has not been observed as a tree in the Houston area but grows as a small understory shade species. It is separated from the similar *Q. falcata* by the longer erect branched hairs on the abaxial surface of the shade leaves. On *Q. falcata* these trichomes are smaller and appressed [see the key in Smith (1994)].

Echinochloa colonum. Most books use *colona* as the specific epithet. See Ward (2005) for this change in orthography.

Paspalum conjugatum. Turner at al. (2003) mapped this species in Cameron County in extreme south Texas with 1 record from Hardin County in the Pineywoods region of east Texas. Diggs et al. (2006) consider the Hardin County specimen to be from a plant cultivated as a lawn grass. For now, the only east Texas collections of native plants are from Liberty County in the Trinity River National Refuge and the Loblolly Unit. The plants were frequent along the southern edge west from the junction with C.R. 2071. Additional specimens at SBSC are from the various units of the National Wildlife Refuge complex in Brazoria County.

DISCUSSION

There are 88 families and 201 genera for the 305 taxa (271 native) on the Loblolly Unit list. Eight families, Poaceae (42 taxa), Cyperaceae (36 taxa), Asteraceae (31 taxa), Scrophulariaceae (11 taxa), Apiaceae (10 taxa), Lamiaceae (9 taxa), Fagaceae (8 taxa), and Fabaceae (7 taxa) account for 50 % of all taxa collected.

We compared the present list of species for Loblolly Unit with the species reported by Turner et al. (2003) in their *Atlas of the Vascular Plants of Texas* and found that 115 taxa, 37.7 % of the species on the Loblolly Unit list, are not reported in Liberty County in that source. This result is not surprising considering that, until recently, little focused collecting has been undertaken in the Big Thicket region.

While it is the case that our list is incomplete, as are all floras, we believe that we have collected probably 90+ % of the taxa. We estimate that the Loblolly Unit has about 281 to 290 native species/taxa. Of the 7 Units inventoried so far, the following taxa are reported only for the Loblolly Unit: *Hymenocallis liriosme, Cynosciadium digitatum, Rorippa sessiliflora, Commelina diffusa, Ipomoea lacunosa, Eleocharis engelmannii, Hydrolea uniflora, Hypoxis wrightii, Micromeria brownei, Ludwigia sphaerocarpa, Paspalum conjugatum, Ranunculus muricatus, Physalis cinerascens* var. *cinerascens*, and *Verbena urticifolia*. Only 14 taxa are new to this Unit. Thus 95% of the taxa in the Loblolly Unit had already been collected in other units of the Big Thicket National Preserve, which is to be expected since most of the other units possess Floodplain and/or Flatland Hardwood forest communities.

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BOOK NOTICE

Sabeeha Merchant, Winslow R. Briggs, and Vicki L. Chandler (eds). 2008. **Annual Review of Plant Biology: Volume 59.** (ISBN 978-0-8243-1346-3, hbk; ISSN 1543-5008). Annual Reviews Inc., 4139 El Camino Way, P.O. Box 10139, Palo Alto, CA 94303-0139, U.S.A. (**Orders:** www.AnnualReviews.org, science@annualreviews.org, 800-523-8635, 650-493-4400, 650-424-0910 fax). $89.00 indiv., 831 pp., 7 5/8" x 9 3/8".

Contents of Volume 59:

1. Our Work with Cyanogenic Plants—*Eric E. Conn*
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3. Plant Immunity to Insect Herbivores—*Gregg A. Howe and Georg Jander*
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6. Seed Storage Oil Mobilization—*Ian A. Graham*
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9. Plant Proteases: From Phenotypes to Molecular Mechanisms—*Renier A. L. van der Hoorn*
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14. Roots, Nitrogen Transformations, and Ecosystem Services—*Louise E. Jackson, Martin Burger, and Timothy R. Cavagnaro*
15. A Genetic Regulatory Network in the Development of Trichomes and Root Hairs—*Tetsuya Ishida, Tetsuya Kurata, Kiyotaka Okada, and Takuji Wada*
16. Molecular Aspects of Seed Dormancy—*Ruth Finkelstein, Wendy Reeves, Tohru Ariizumi, and Camille Steber*
17. Trehalose Metabolism and Signaling—*Matthew J. Paul, Lucia F. Primavesi, Deveraj Jhurreea, and Yuhua Zhang*
18. Auxin: The Looping Star in Plant Development—*RenŽ Benjamins and Ben Scheres*
19. Regulation of Cullin RING Ligases—*Sara K. Hotton and Judy Callis*
20. Plastid Evolution—*Sven B. Gould, Ross F. Waller, and Geoffrey I. McFadden*
21. Coordinating Nodule Morphogenesis with Rhizobial Infection in Legumes—*Giles E.D. Oldroyd and J. Allan Downie*
22. Structural and Signaling Networks for the Polar Cell Growth Machinery in Pollen Tubes—*Alice Y. Cheung and Hen-ming Wu*
23. Regulation and Identity of Florigen: FLOWERING LOCUS T Moves Center Stage—*Franziska Turck, Fabio Fornara, and George Coupland*
24. Plant Aquaporins: Membrane Channels with Multiple Integrated Functions—*Christophe Maurel, Lionel Verdoucq, Doan-Trung Luu, and VŽronique Santoni*
25. Metabolic Flux Analysis in Plants: From Intelligent Design to Rational Engineering—*Igor G.L. Libourel and Yair Shachar-Hill*
26. Mechanisms of Salinity Tolerance—*Rana Munns and Mark Tester*
27. Sealing Plant Surfaces: Cuticular Wax Formation by Epidermal Cells—*Lacey Samuels, Ljerka Kunst, and Reinhard Jetter*
28. Ionomics and the Study of the Plant Ionome—*David E. Salt, Ivan Baxter, and Brett Lahner*
29. Alkaloid Biosynthesis: Metabolism and Trafficking—*Jšrg Ziegler and Peter J. Facchini*
30. Genetically Engineered Plants and Foods: A Scientist's Analysis of the Issues (Part I)—*Peggy G. Lemaux*

Cumulative Index of Contributing Authors, Volumes 49–59
Cumulative Index of Chapter Titles, Volumes 49–59

J. Bot. Res. Inst. Texas 2(2): 1490. 2008

NEPTUNIA PLENA (FABACEAE: MIMOSOIDEAE) REDISCOVERED IN TEXAS

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ABSTRACT

On October 17, 1938, Robert Runyon collected a specimen of *Neptunia plena* from a shallow pond south of Armstrong in Kenedy County, Texas. No subsequent collections from Texas have been reported. It was assumed that it was not a permanent member of our flora. On October 27, 2007, a population of *N. plena* was found near the same locality.

RESUMEN

El 17 de octubre de 1938, Robert Runyon recogió un espécimen de *Neptunia plena* de una charca somera de Armstrong en el condado de Kenedy, Tejas. No se ha encontrado ninguna colección posterior de Tejas. Fue asumido que no era un miembro permanente de nuestra flora. En octubre de 27, 2007, una población del *N. plena* fue encontrada cerca del mismo lugar.

Neptunia plena is commonly found in the West Indies, Mexico, and South America (Correll & Johnston 1970). It was introduced into India. It is a sprawling perennial which grows in ponds or damp soils. The stems growing in water are horizontal and become covered with a brown, spongy fungal growth (when the fungus is present); in soil, the stems are more or less erect. The younger stems produce adventitious roots when submerged in water. The leaves are sensitive, twice compound, about 6.5 cm long, with 2 to 5 pairs of pinnae. The petiole bears a gland positioned immediately below the lowest pair of pinnae (Fig. 2). The flowers are in globose or ovoid heads bearing two types of flowers. The lower portion of the head bears large, shiny, brilliant yellow staminodes; the upper portion of the head bears small whitish, normal flowers (Fig. 1). The legumes are flattened, about 2 cm long and 6 mm broad.

Neptunia plena was collected in Kenedy County by Robert Runyon on October 17, 1938. According to label information on his specimen at TEX (*R. Runyon 1959*), it was growing in a shallow pond south of Armstrong. Since that time, there have been no reports of the species from Texas. The natural conclusion was that it was probably not a persistent part of the Texas flora. It was so noted in the *Manual of the Vascular Plants of Texas* (Correll & Johnston 1970).

On October 27, 2007, we found a population growing in the median of Highway 77 in an ephemeral pond in Kenedy county, 4.8 miles north of the Willacy County border. This is the same general area as the Runyon collection. Growing nearby were *Nymphaea elegans*, *Ludwigia decurrens*, *Eleocharis sp.*, *Prosopis glandulosa*, and *Physalis pubescens*. The median landscape is mowed along the edge of the highway, but the middle sections are left in the "wild" state to help support the development of native species. The soil type is sandy loam with underlying clay which helps to hold water in the ponds after heavy rains. The rainfall average is twenty six inches per year, but there are cycles of drought years followed by one or a few wetter years. It is during these wetter years that the ponds form.

After examining other similar habitats, we found *N. plena* growing in several ponds near the one in which it was first seen. Another population was found in Cameron County on Highway 1847, four miles north of Highway 510. A specimen was not collected. In most localities, *N. pubescens* was found growing nearby.

Our conclusion is that the plants emerge during the periodic wet seasons and produce flowers and seeds. When the ponds disappear during the dry years, the plants become dormant and persist as seeds or perhaps underground propagules.

J. Bot. Res. Inst. Texas 2(2): 1491 – 1493. 2008

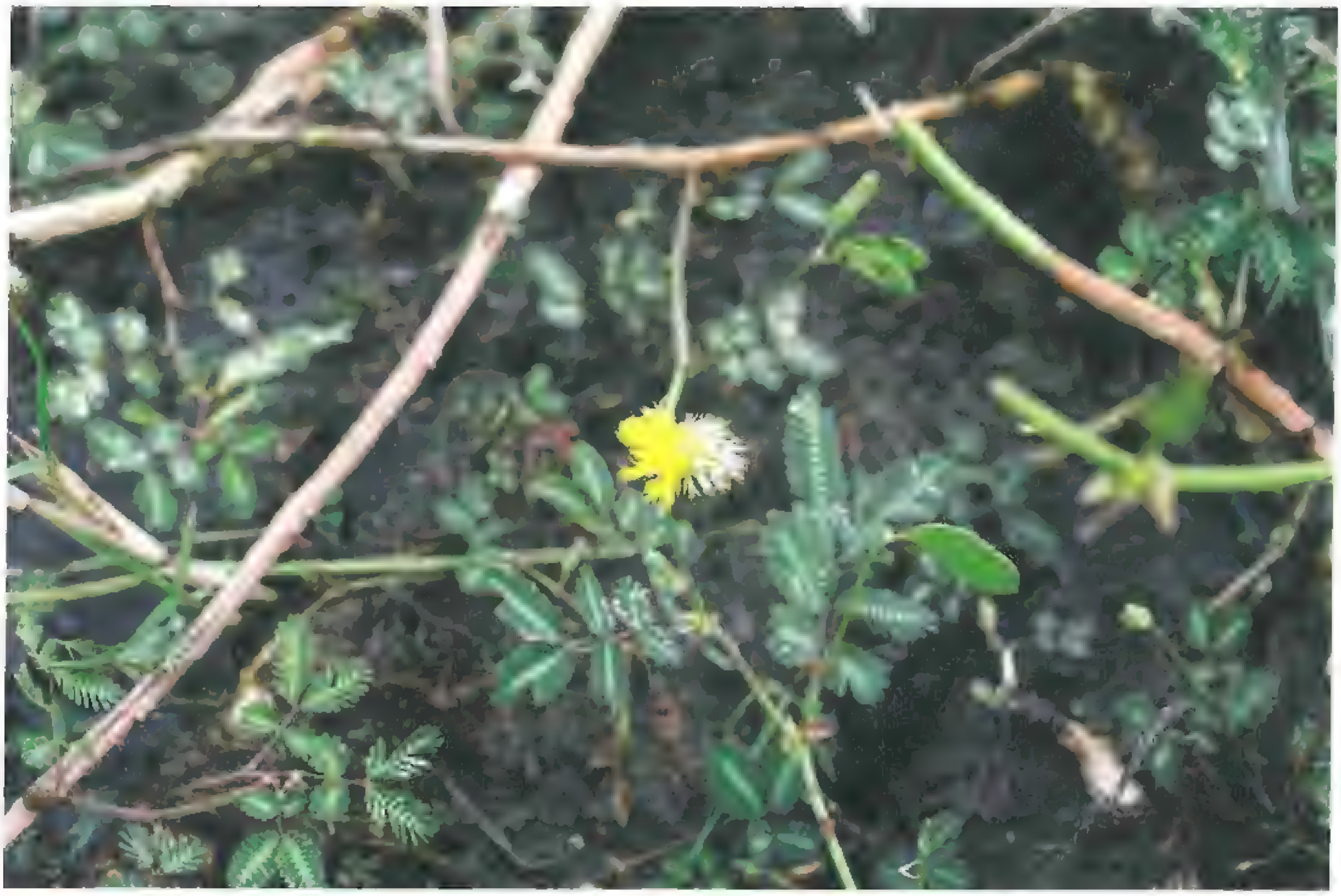

Fig. 1. Flower head and immature fruit.

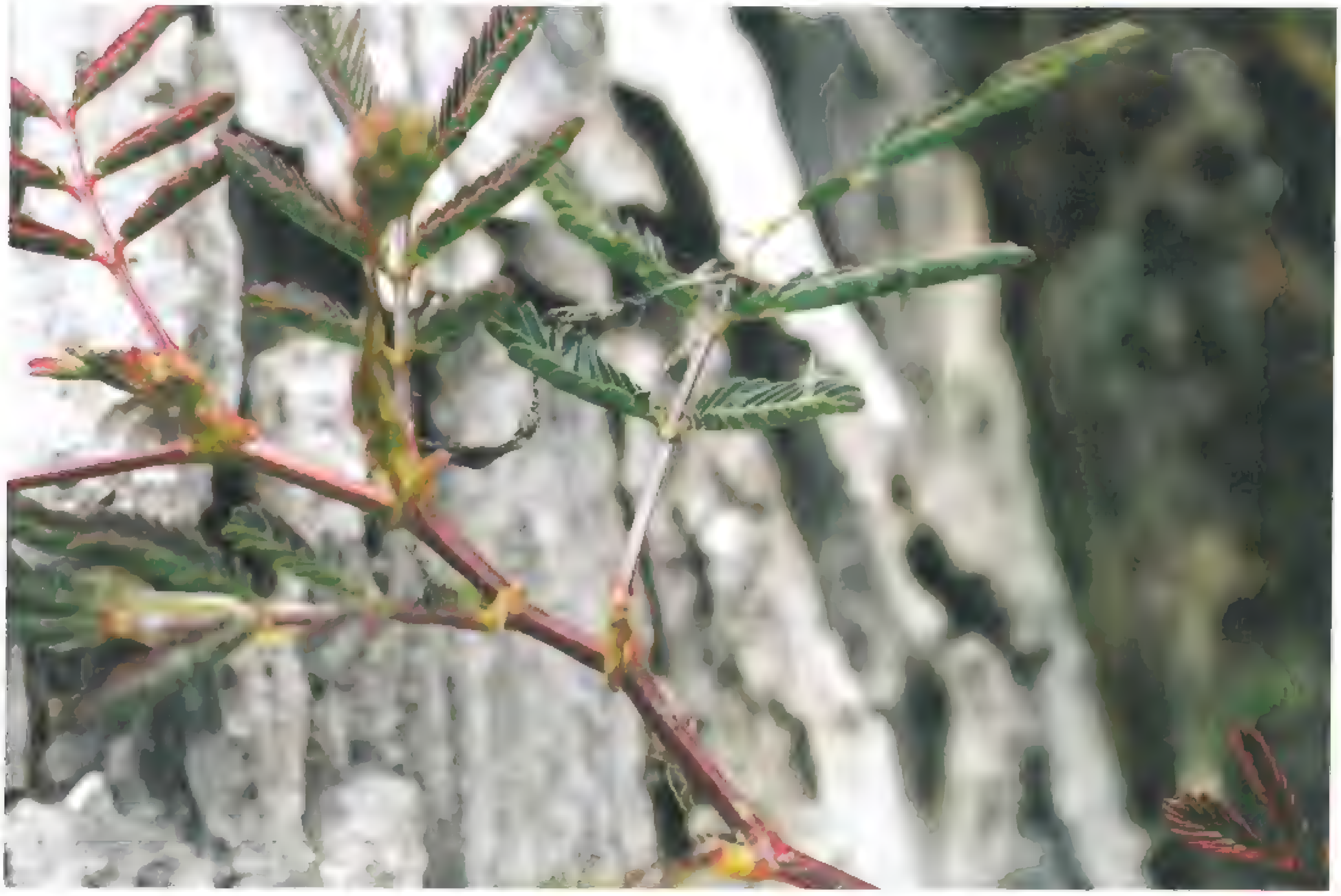

Fig. 2. Leaf with petiolar gland.

There are several reasons why *N. plena* could have been flourishing in this area without being noticed. There has not been much field activity in the area, as evidenced by the relatively few specimens available. Secondly, during the periodic drought years, the plants would be dormant. Also, the blooming season may be short. We returned to the site one week later, and there were few blooms. A further difficulty is the presence of two similar Neptunias in the area. *N. pubescens* has an inflorescence similar to that of N. *plena*, but it lacks the petiolar gland of that species. *N. lutea* also has a yellow globose or ovoid inflorescence, but the flowers are all the same type. At a distance all three species would look alike.

Voucher specimen: **TEXAS. Kenedy Co.:** Hwy. 77, 4.8 mi N of Willacy County border, ephemeral pond in median, 27 Oct 2007, *Richardson and King* 3365 (BRIT, TEX).

ACKNOWLEDGMENTS

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ANNOUNCEMENTS

2008 Delzie Demaree Travel Award Recipients

The 20th Annual Delzie Demaree Travel Award was presented at the 55th Annual Systematics Symposium (17–18 Oct 2008) at the Missouri Botanical Garden, St. Louis. Two students were presented the Travel Award: **Patricia Lu-Irving**, University of Washington, Seattle and **Piero Protti**, University of Kansas, Lawrence.

The 2008 Travel Awards were underwritten by **1)** Delzie Demaree Travel Award Endowment, **2)** Members of the Delzie Demaree Travel Award Committee, and **3)** John Clayton Chapter of the Virginia Native Plant Society.

Anyone interested in making a contribution to Delzie Demaree Endowment Fund, which supports the travel award, may make contributions by VISA or MasterCard or by a check, payable to Botanical Research Institute of Texas, to Barney Lipscomb, 500 E 4th Street, Fort Worth, TX 76102-4025, U.S.A. 1-817-332-7432; Email: barney@brit.org. Thank you.

The 2009 Applications for the Delzie Demaree Travel Award

Applications for the 2009 Delzie Demaree Travel Award should include a letter from the applicant telling how symposium attendance will benefit his/her graduate work and a letter of recommendation sent by the major professor. Please send letters of application to: Dr. Donna M.E. Ware, P.O. Box 8795, Herbarium, Biology Department, The College of William and Mary, Williamsburg, VA 23185-8795, U.S.A. 1-757-221-2799; Email: ddmware@wm.edu. The period for receiving applications will end three weeks prior to the date of the symposium if a sufficient number of applications are in hand at that time. Anyone wishing to apply after that date should inquire whether applications are still being accepted before applying. The Systematics Symposium dates for 2009 are 9–10 October 2009.

The Delzie Demaree Travel Award was established in 1988 honoring Delzie Demaree who attended 35 out of a possible 36 symposia before he died in 1987. Delzie Demaree was a frontier botanist, explorer, discoverer, and teacher. His teaching career as a botanist began in Arkansas at Hendrix College in 1922. He also taught botany at the University of Arkansas, Navajo Indian School, Yale School of Forestry, Arkansas A&M, and Arkansas State University at Jonesboro where he retired as professor emeritus in 1953. One of the things he enjoyed most as a botanist was assisting students with their field botany research.

J. Bot. Res. Inst. Texas 2(2): 1494. 2008

ASCLEPIAS HIRTELLA (APOCYNACEAE) NEWLY DOCUMENTED FOR THE FLORA OF TEXAS

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ABSTRACT

Asclepias hirtella (Pennell) Woodson is reported as new for Texas in Lamar, Fannin and Henderson counties.

ABSTRACT

Se cita *Asclepias hirtella* (Pennell) Woodson como nueva para Texas en los condados de Lamar, Fannin y Henderson.

Asclepias hirtella (Pennell) Woodson was not reported for Texas by Correll and Johnson (1970), Jones et al. (1997), Diggs et al. (1999), or Turner et al. (2003). Recent field work at Camp Maxey, a Texas Army National Guard facility in Lamar County, has revealed the presence of the species in open *Schizachyrium scoparium* grassland, where it was rare (Fig. 1). The plants were growing in soils mapped as Bernaldo fine sandy loam, "a brown, slightly acid fine sandy loam" found on the "tops and sides of ridges" (Ressell 1979), situated atop an underlying geology of Blossom Sand (Shelby et al. 1966). Common forb associates included *Solidago nitida*, *Vernonia texana*, *Liatris elegans* var. *elegans*, *Polygala incarnata*, and *Rudbeckia hirta*.

Asclepias hirtella and the closely related *A. longifolia* are in the subgenus *Acerates* (Ell.) Woodson. *Asclepias hirtella* is "a species of Midwestern prairies and barrens" (Weakley 2007) and grows in bottomland as well as upland prairies, glades, pastures, roadsides and railroads (Yatskievych 2006). It occurs from Georgia to Louisiana, Oklahoma, Kansas, Minnesota, southern Ontario, West Virginia and Tennessee. *Asclepias longifolia*, by contrast, occurs along the Gulf and Atlantic coastal plain (Woodson 1954) from southeast Texas through southern Delaware. Turner et al. (2003) mapped collections of *A. longifolia* from Newton, Jasper, Tyler, Hardin, Liberty and Galveston counties as well as what he considered a very disjunct collection from Fannin County. An examination of the Fannin County specimen indicates that it is actually *A. hirtella*, as is an additional Henderson County collection cited below. These specimens suggest the species is rare in northern and eastern Texas.

This species appears to occur with more regularity in nearby Oklahoma and has been collected several times in nearby McCurtain, Pushmataha and Atoka counties (Pennell 1919; Hoagland et al. 2004). In McCurtain County the species is found at Red and Grassy Slough in the Red River Valley (Hoagland & Johnson 2004), both of which are very close to Texas.

The following key, taken from Woodson (1954), should allow these similar species to be identified:

1. Inflorescences lateral, numerous, and dense and nearly spherical, the flowers very slightly tinted with purple; plants relatively stout ………… **Asclepias hirtella**
1. Inflorescences both terminal and lateral, the lateral rather few, rather lax and hemispherical, the flowers rather liberally tinted with purple; plants rather slender ………… **Asclepias longifolia**

Voucher specimens: **TEXAS. Fannin Co.:** 1 mi N of Monkstown on FM 79, in open valley and grassy areas, 19 May 1963, *D.S. Correll & H.B. Correll 27491* (LL). **Henderson Co.:** 9.5 mi S of Athens, low ground, sandy clay, 22 Aug 1951, *L.H. Shinners 19106* (BRIT). **Lamar Co.:** Camp Maxey TXARNG Training Facility in open grassland, 33.41675 N & 95.32904 W, 17 Aug 2007, *M. White s.n.* (BRIT).

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I am grateful to Natural Resource Specialist Katherine Crosthwaite of the Texas Army National Guard and the staff at Camp Maxey for access to the site. I would especially like to thank both Walter Holmes and

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J. Bot. Res. Inst. Texas 2(2): 1495 – 1496. 2008

Barney Lipscomb, whose careful editing greatly improved the manuscript. Amanda Neill found the collection from Henderson County. Special thanks to Bill Carr for tracking down the Correll and Correll specimen from Fannin County and for numerous suggestions on the manuscript. Joe Jackson, a librarian at Paris Junior College, for helping with interlibrary loans.

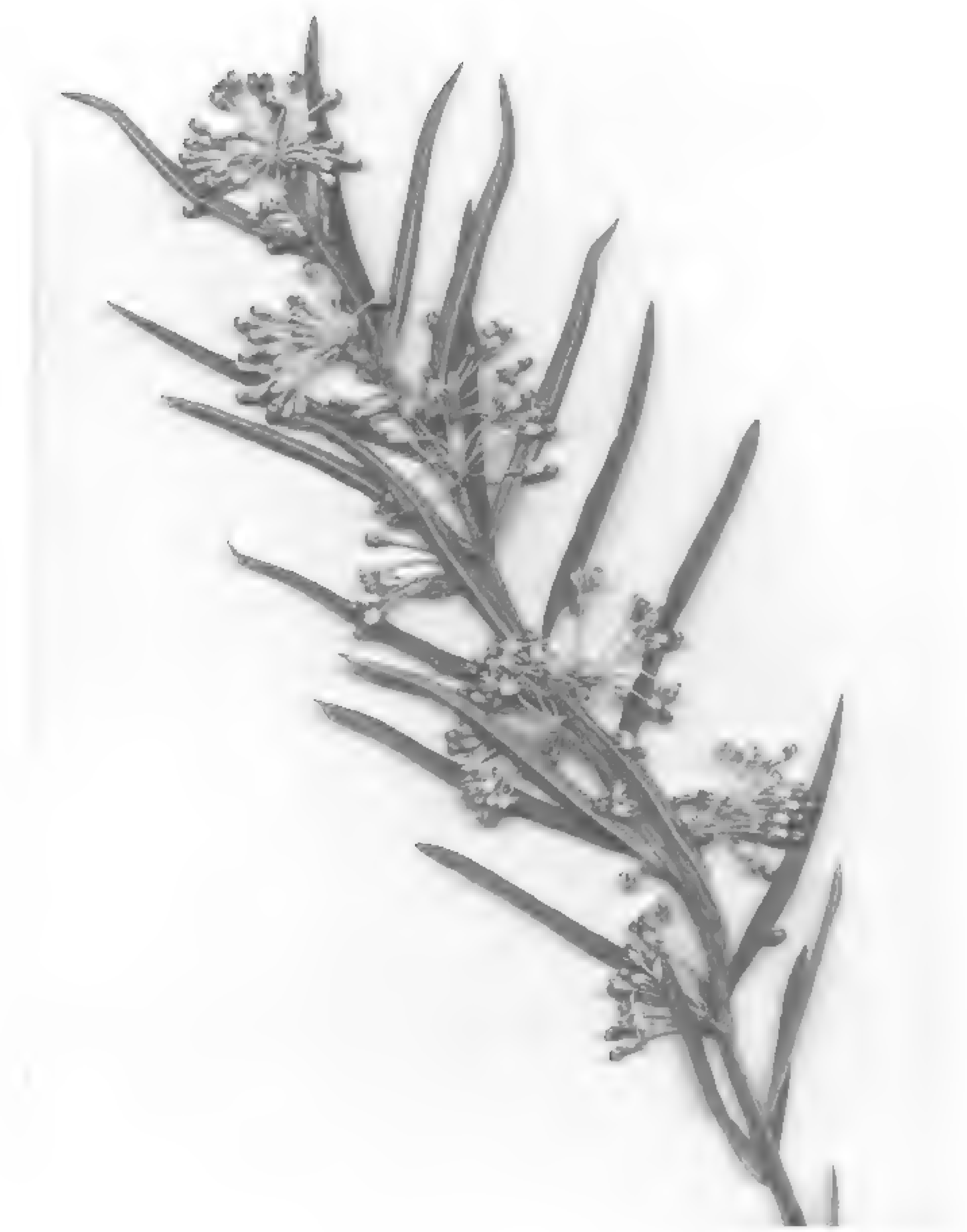

Fig. 1. Scan of *Asclepias hirtella* collected from Lamar County, Texas, 17 Aug 2007 (*Matt White s.n.*, BRIT).

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LILAEOPSIS CAROLINENSIS (APIACEAE) A SPECIES NEW TO TEXAS AND A KEY TO *LILAEOPSIS* IN TEXAS

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ABSTRACT

The occurrence of *Lilaeopsis carolinensis* J.M. Coult. & Rose is reported new to Texas and a key to the species of *Lilaeopsis* in Texas is provided.

Key Words: *Lilaeopsis carolinensis*, new to Texas

RESUMEN

Se reporta la presencia de *Lilaeopsis carolinensis* J.M. Coult. & Rose, en Texas y se provee una clave para el especies *Lilaeopsis* en Texas.

Lilaeopsis carolinensis was recently collected at the Texas Parks and Wildlife Department, J.D. Murphree Wildlife Management Area, Jefferson County, Texas, in an interior ditch of compartment 2 on 15 April 2008. The species occurred in a shallow, freshwater canal associated with *Hydrocotyle* sp. and *Salvinia minima* J.G. Baker in a floating vegetation mat. The specimen was identified using Radford et al. (1968), Godfrey and Wooten (1981), and Tobe et al. (1998).

This species is native to the southeastern U.S.A. (USDA-NRCS 2008) and likely a recent introduction to Texas, not having been recorded by Correll and Johnston (1970), Correll and Correll (1975), Affolter (1985), Hatch et al. (1990), Jones et al. (1997), or The Flora of Texas Database (2008). The following herbaria (TEX/LL; SHSU; and ASTC) searched their collections for Texas specimens of this species without finding specimens.

The North American distribution of *L. carolinensis* extends from Virginia south to Florida and west to Louisiana [(Radford et al. (1968), Godfrey and Wooten (1981), and Tobe et al. (1998)]. State distributions are AL, AR, FL, GA, LA, MS, NC, SC, and VA (USDA-NRCS 2008). This is the first reported and vouchered collection of the species from Texas. This discovery in Texas is not unexpected because of its close proximity to similar Louisiana habitats from which the species is known.

Another species of *Lilaeopsis*, *L. chinensis* (L.) Kuntze, is also known from a single Texas collection (*L. Brown & Marcus 16926*) from Chambers County. This specimen was collected in 1998. The following key will serve to identify the two Texas species. Tobe et al. (1998) and Radford et al. (1968) provide illustrations of both species.

A KEY TO THE SPECIES OF *LILAEOPSIS* IN TEXAS

1. Peduncles shorter than leaves; pedicels 5–10 mm long; leaves (phyllodes) 10–30 cm long with 7–15 septa; habitat fresh water ____ **L. carolinensis**
2. Peduncles longer then leaves; pedicels 3–4 mm long; leaves (phyllodes) 1–5 cm long with 4–6 septa; habitat brackish water ____ **L. chinensis**

Lilaeopsis carolinensis Coult. & Rose, (**Fig. 1**). Carolina glasswort. Rhizomatous, perennial herbs; stems adventitious, ca 50 cm long, horizontal, roots at nodes; leaves (phyllodes) 10–30 cm long, clavate to linear, with 7–15 transverse septa; peduncles much shorter than leaves; pedicels 5–10 mm long; umbels 5–15 flowered, simple; sepals absent or minute; petals 5, white; fruits 2–2.5 mm diameter, mericarps ovate, veins prominent; flowering period March to June.

J. Bot. Res. Inst. Texas 2(2): 1497 – 1498. 2008

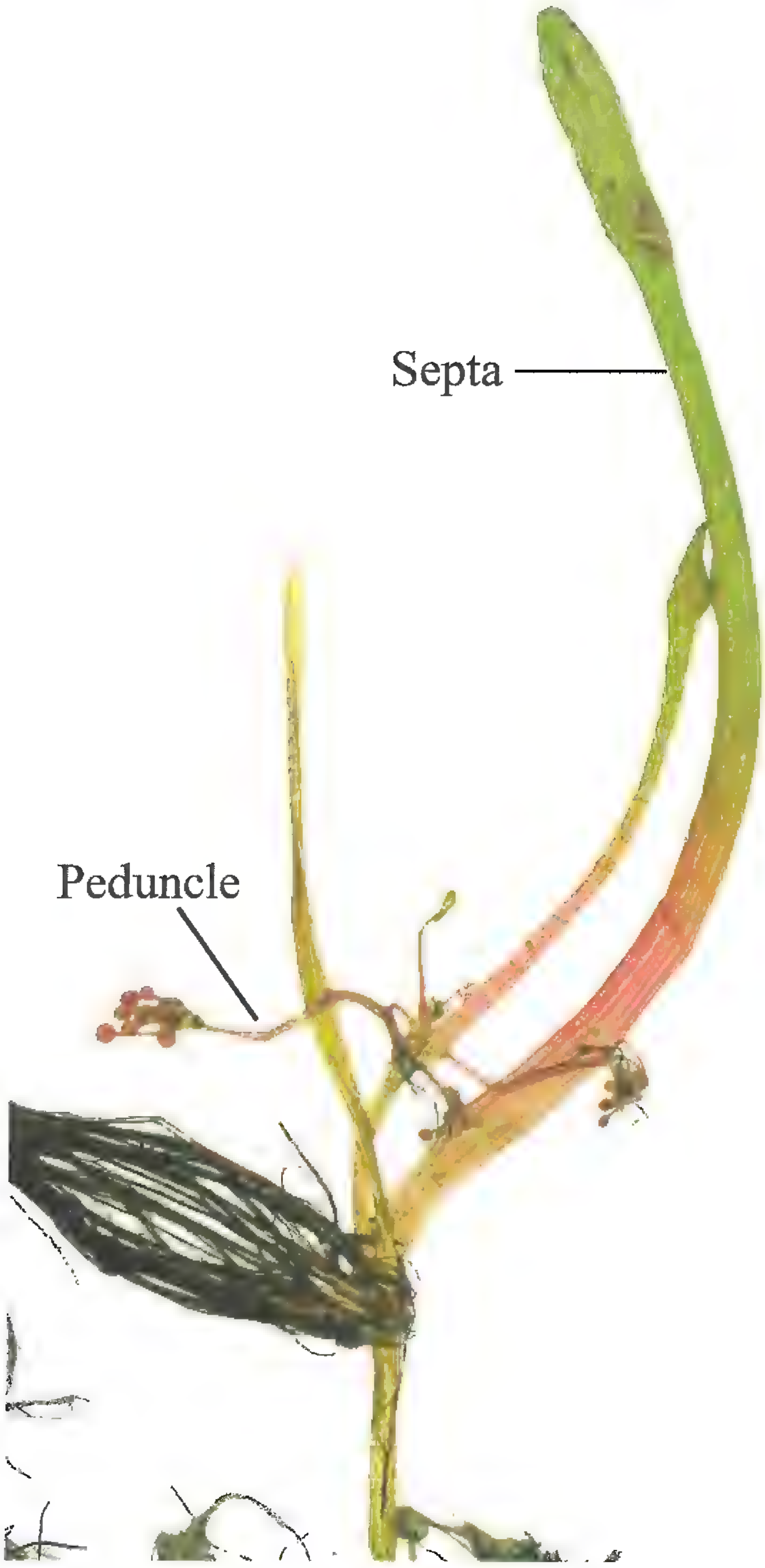

Fig. 1. Digital image of *Lilaeopsis carolinensis* showing important septa and peduncle characteristics.

Specimen examined. **TEXAS. Jefferson Co.:** Texas Parks and Wildlife Department, J.D. Murphree Wildlife Management Area in ditch within Compartment 2. Shallow, fresh water. 15 Apr 2008 *Slack s.n.* (TAES). Synonym *L. attenuata* auct. non (Hook. & Arn.) Fern.

Lilaeopsis chinensis (L.) Kuntze, EASTERN GRASSWORT. Rhizomatous, perennial herbs; stems ca. 50 cm long, horizontal, roots at nodes; leaves (phyllodes) 1–5 cm long, clavate to linear, with 4–6 transverse septa; peduncles longer than leaves; pedicels 3–4 mm long; umbels 4–10 flowered, simple; sepals absent or minute; petals 5, white; fruits 2–2.5 mm diameter, mericarps ovate, veins prominent; flowering period March to June. Tidal marshes, brackish. Synonym *L. lineata* (Michx.) Greene. See PLANTS Database (USDA-NRCS 2008) for the distribution.

ACKNOWLEDGMENTS

The authors thank the curators of the following herbaria for a search of their collections for species records in Texas; TEX/LL, ASTC, and SHSU.

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REVIEWERS:
VOLUME 1 (2007) AND VOLUME 2(2008)

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Acevedo-Rodriguez, Pedro
Ahmed, Habib
Alex, Betty
Alford, Mac H.
Allorge, L.
Allred, Kelly W.
Almeda, Frank
Amorim, André M.
Anderson, John L.
Anderson, Loran C.
Anjaria, Jayvir
Arbeláez, Alba L.
de Assis, Marco Antônio
Austin, Daniel F.
Aymard C., Gerardo

Baeza, Carlos M.
Bailey, Donovan
Bain, John F.
Baldwin, Bruce G.
Barkworth, Mary E.
Barrie, Fred R.
Barringer, Kerry A.
Basinger, Mark
Bauml, James A.
Beard, Catherine
Blanco, Mario A.
Bogler, David J.
Booth, Helga Ochoterena
Boufford, David E.
Boyce, Peter
Brach, Anthony
Brouillet, Luc
Brown, Larry E.
Brown-Marsden, Margaret
Bryson, Charles T.
Burger, William C.
Buthod, Amy
Butterworth, Charles A.

Campos-Ríos, María G.
Cantino, Philip D.
Carlquist, Sherwin
Carr, William R.
Castelo, Elena
Catharino, Eduardo L. M.
Cerón, Carlos
Cerros-Tlatilpa, Rosa
Chambers, Henrietta L.
Chester, Edward W.
Christensen, Knud Ib
Clancy, Keith E.
Clark, John L.
Clark, Lynn G.
Clark-Simpson, Carolyn A.
Clemants, Steven E.
Conn, Barry J.
Costea, Mihai
Croat, Thomas B.
Cusick, Allison W.

Daniel, P.
Darbyshire, Stephen J.
Demissew, Sebsebe
Denham, Miriam L.
Denslow, Michael W.
Dessein, Steven
Diamond, Alvin
Dickinson, Timothy A.
Diggs, George M.
Dillon, Michael O.
Dorr, Laurence J.
Doyle, James A.
Dutton, Bryan E.

Eberwein, Roland K.
Edeoga, Hilary O.
Edwards, Christine E.
Eggli, Urs
Elisens, Wayne J.
Endress, Mary E.
Ertter, Barbara
Ervin, Gary
Espejo-Serna, Adolfo
Estrada C., A. Eduardo
Ezcurra, Cecilia

Fantz, Paul
Farruggia, Frank
Felger, Richard S.
Ferguson, Diane M.
Feuillet, Christian
Finot, Victor
Frederick, Lafayette
Freire-Fierro, M.Sc. Alina
Freitas, Maria de Fátima
Freudenstein, John V.
Fritsch, Peter W.
Funk, Vicki A.

Gandhi, Kanchi
García Mendoza, Abisai J.
García R., Ignacio
García-Armora, Pedro Ramírez
Gardner, Rick
George, Robert
Gereau, Roy
Gilbert, Larry
Giraldo-Cañas, Diego
Giussani, Liliana Monica
Gomez-Sanchez, Maricela
González-Elizondo, M. Socorro
Goodrich, Sherel
Goyder, David
Grant, Jason R.
Guaglianone, Encarnación R.
Guala, Gerald F.

Haberle, Rosemarie (Romey) C.
Hágsater, Eric
Hall, David W.
Halse, Richard R.
Hansen, Bruce F.
Harcombe, P.A.
Harms, Vernon L.
Hartman, Ronald L.
Hatch, Stephan L.
Hays III, John F.
Heil, Kenneth D.
Helliwell, Richard
Herendeen, Patrick
Hess, William
Heydler, Susan O.
Hill, Sonnia
Hill, Steven R.
Hind, D.J. Nicholas
Hipp, Andrew
Hodgson, Wendy C.
Holmes, Walter C.
Holst, Bruce K.

Iltis, Hugh H.

Jarvis, Charlie
Jensen, Elizabeth A.
Jiménez, Concepcion Rodriguez
Johnson, Dale E.
Johnson, George P.
Jones, Ronald L.
Jones, Thomas H.
Jorgensen, Peter M.
Judd, Walter S.
Judziewicz, Emmet J.

Kallunki, Jacquelyn A.
Kaul, Robert B.
Kawasaki, Lucia
Keith, Eric L.
Kelso, Sylvia
Kirkbride, Jr., Joseph H.
Kirschner, Jan
Knox, Eric
Kral, Robert
Krings, Alexander
Krosnick, Shawn
Kruse, Dale A.
Kvacek, Zlatko

Lakshminarasimhan, P.
Lammers, Thomas G.
Lance, Ron
Landrum, Leslie R.
Lavin, Matt
Lawson, Cheryl A.
Lemke, David E.
León, Blanca
Levin, Rachel A.
Lewis, Walter H.
Lidén, Magnus
Liesner, Ron
Lim, A.L.
Livshultz, Tatyana
Lohmann, Lúcia G.
Lombarda, Julio A.
Lorence, David
Lowrey, Timothy K.
Lucas, Eve
Luteyn, James L.

MacDougal, John
MacRoberts, Michael H.
Magallanes, Arturo Solis
Magrath, Lawrence K.
Mahmood, A.
Majure, Lucas
Malik, Kamal
Manchester, Steven R.
Martine, Christopher T.
Maschinski, Joyce
Maughan, Jeff
Mayfield, Mark H.
Mazzola, Eugene
McCarthy, Brian C.
McCauley, Ross A.
McCook, Lucile M.

J. Bot. Res. Inst. Texas 2(2): 1499 – 1500. 2008

McCullough, Deanna
McDonald, Charles B.
McDowell, Tim
McLaughlin, Steven P.
McNeill, John
McPherson, Gordon
Mejia Saules, Teresa
Mellichamp, T.L.
Mereles (FCQ), Fátima
Miller, Dennis L.
Miller, James S.
Mirza, Sarwat
Moore, Gerry
Mora-Olivo, Arturo
Morgan, David
Mort, Mark Eugene
Morton, Cynthia M.
Morton, J.K.
Mueller, Jochen
Murray, David F.
Mygatt, Jane

Naczi, Robert F.C.
Nasir, Mahmood
Nee, Michael
Neill, Amanda
Neill, David
Nelson, Allan D.
Nelson, John B.
Nemoto, Tomoyuki
Nesom, Guy
Nickrent, Daniel L.
Nicolson, Dan H.
Norman, Eliane M.
Noyes, Richard D.

Oliveira, Reyjane Patricia
Oppel, Marissa
Ortiz, Rosa
Ortiz Diaz, Juan Javier

Pandey, Arun K.
Patterson, Robert W.
Patterson, Thomas
Peck, James H.
Pedraza, Paola
Pennington, R. Toby
Penskar, Mike
Perez-Cortez, Silvia
Perkins, Kent
Persson, Claes
Peterson, J. Scott
Peterson, Paul M.
Pipoly II, John J.
Poindexter, Derick B.
Poole, Jackie
Porcher, Richard
Porter-Utley, Kristen E.
Prado, Darién E.
Prado, Jefferson
Pratt, Donald B.
Provance, Mitch
Pruski, John F.
Pupulin, Franco

Quedensley, Taylor Sultan
Quintana, M.Sc. Catalina

Rao, R.R.
Rebman, Jon P.
Reed, Monique
Reid, Christopher
Reif, Brian
Reveal, James L.
Reznicek, Anton (Tony) A.
Rhoads, Ann
Rinker, H. Bruce
Riser II, James P.
Roalson, Eric H.
Roberts, Roland
Rodríguez, José Delgadillo
Romero, Gustavo
Rosen, David J.
Rosso, Samuel W.
Rothrock, Paul
Russell, George F.
Ryburn, Adam K.

Saarela, Jeff M.
Sabatier, Daniel
Saklani, Prem L.
Salazar Chávez, Gerardo A.
Sano, Paulo T.
Santos-Gonçalves, Ana Paula
Sasek, Thomas
Sasidharan, N.
Saunders, Richard
Sawyer, Neil W.
Schelz, Charlie
Semple, John C.
Shafer, Harry
Shaw, Joey
Shipes, Barbara Greene
Silverstone-Sopkin, Philip A.
Simoes, Andre
Sinha, Riya
Siqueiros, Maria Elena
Sivinski, Robert C.
Skinner, Mark
Skog, Laurence E.
Smith, James F.
Smith, S. Galen
Smith, Tyler
Snow, Neil
Sobral, Marcos
Sosa, Victoria
Spellenberg, Richard
Spence, John
Stancík, Daniel
Stapleton, C.M.A.
Stevens, Peter F.
Strother, John L.
Szlachetko, Dariusz L.

Talent, Nadia
Taylor, David D.
Telfair II, Ray
Teppner, Herwig
Terrazas, Tereza
Terrell, Edward E.
Tershy, Berny
Thomas, R. Dale
Tiehm, Arnold
Timme, Stephen L.
Tiner, Ralph W.
Tranel, Patrick
Triplett, Jimmy K.
Tripp, Erin
Trock, Debra K.
Turland, Nicholas J.
Turner, Billie L.

Urbatsch, Lowell E.

Valdés-Reyna, Jesús
Valencia A., Susana
van de Veire, Jacqueline
Vanderpool, Staria S.
VanDevender, Thomas R.
Venu, P.
Villarreal-Quintanilla, José A.
Villaseñor, Jose Luis
Voss, Edward G.

Wagner, Warren L.
Walck, Jeffrey Lee
Wallace, Gary D.
Ward, Daniel B.
Ware, Stewart A.
Weakley, Alan S.
Weber, William A.
Weitzman, Anna L.
Wheeler, Elisabeth
White, David S.
Whittemore, Alan
Whitten, William Mark
Widjaja, E.A.
Wiersema, John H.
Wilbur, Robert L.
Wilkie, Peter
Williams, Justin
Williams, Norris H.
Wilson, Barbara L.
Wojciechowski, Martin F.
Woodland, Dennis W.
Worthington, Richard D.
Wunderlin, Richard P.

Zhou, Lihua
Ziljstra, Gea
Zmarzty, Sue
Zona, Scott
Zuloaga, Fernando

INDEX TO 233 TITLES WITH 324 AUTHORS: VOLUME 1 (2007) AND VOLUME 2(2008)

We know you have a choice. Thank you for choosing and supporting *Journal of the Botanical Research Institute of Texas.*

2C DNA content values in **Amaranthus** (Amaranthaceae) by Donald B. Pratt, Shalini N. Jhangiani, and Robert J. Wiggers—**2(2):**1219

A floristic survey of National Park Service areas of Timucuan Ecological and Historic Preserve (including Fort Caroline National Memorial), Duval County, Florida by Wendy B. Zomlefer, David E. Giannasi, and Walter S. Judd—**1(2):**1157

A floristic survey of vascular plants over parts of northeastern New Mexico by Michael H. Schiebout, Donald L. Hazlett, and Neil Snow—**2(2):**1407

A new gypsophilous species of **Erigeron** (Asteraceae: Astereae) from northeastern Mexico by Guy L. Nesom—**1(2):**891

A new hedge-nettle (**Stachys:** Lamiaceae) from the interior highlands of the United States, and keys to the southeastern species by John B. Nelson—**2(2):**761

A new name for the well-known **Asplenium** (Aspleniaceae) from Hale County, Alabama by Brian R. Keener and L.J. Davenport—**1(1):**103

A new species and two new combinations in **Potentilla** sect. **Niveae** (Rosaceae) by David F. Murray and Reidar Elven—**1(2):**811

A new species of **Alocasia** (Araceae: Colocasieae) from Panay Island, Philippines by Melanie P. Medecilo, George C. Yao, and Domingo A. Madulid—**1(2):**815

A new species of **Chusquea** sect. **Verticillatae** (Poaceae: Bambusoideae) from Ecuador by Lynn G. Clark, Christopher D. Tyrrell, Jimmy K. Triplett, and Amanda E. Fisher—**1(2):**847

A new species of **Lasiolaena** (Asteraceae: Eupatorieae: Gyptidinae) from Bahia, Brazil by Nádia Roque, Silvana C. Ferreira, and Harold Robinson—**2(2):**811

A new species of the fern genus **Doryopteris** (Pteridaceae) from southeastern Brazil by Alexandre Salino—**2(2):**843

A new variety of **Festuca roemeri** (Poaceae) from the California Floristic Province of North America by Barbara L. Wilson—**1(1):**59

A new variety of **Humboldtia** (Fabaceae: Caesalpinioideae) from the Western Ghats of India by P.S. Udayan, K.V. Tushar, and Satheesh George—**1(1):**121

A note on the type locality of **Oenothera arizonica** (Onagraceae) by Kathryn Mauz—**1(1):**483

A novel design for a light weight and durable field press by Charles T. Bryson and Richard Carter—**2(1):**517

A phylogeny of **Bejaria** (Ericaceae: Ericoideae) based on molecular data by Catherine M. Bush and Kathleen A. Kron—**2(2):**1193

A phytogeographical analysis of **Taxus** (Taxaceae) based on leaf anatomical characters by Richard W. Spjut—**1(1):**291

A revision of **Colicodendron** (Capparaceae) by Xavier Cornejo and Hugh H. Iltis—**2(1):**75

A second species of **Cyclopogon** s.s. (Orchidaceae: Spiranthinae) by Eric A. Christenson—**1(2):**1001

A synopsis of **Pachyphyllum** (Orchidaceae) by Eric A. Christenson—**2(1):**285

A synopsis of the Mexican and Central American species of **Vaccinium** (Ericaceae) by Robert L. Wilbur and James L. Luteyn—**2(1):**207

A taxonomic revision of **Crataegus** series **Lacrimatae** (Rosaceae) by J.B. Phipps and K.A. Dvorsky—**2(2):**1101

Additional noteworthy collections of **Cyperus drummondii** (Cyperaceae) from Texas and first report from Mexico by David J. Rosen and Richard Carter—**1(1):**779

Agasthiyamalaia (Clusiaceae), a new genus for **Poeciloneuron pauciflorum,** an endemic and endangered tree of Western Ghats, India by S. Rajkumar and M.K. Janarthanam—**1(1):**129

An Early Cretaceous angiosperm fossil of possible significance in rosid floral diversification by George O. Poinar, Jr., Kenton L. Chambers, and Ron Buckley—**2(2):**1183

Analysis of the completeness of vascular plant records in Florida by Justin K. Williams and Anica Debelica—**2(2):**1363

Anatomía foliar de algunas gramíneas alpinas y subalpinas del Eje Volcánico Transversal, México by Maricela Gómez-Sánchez and Kathia Georgina Téllez-Pimienta—**2(1):**495

Anisocapparis y **Monilicarpa:** dos nuevos géneros de Capparaceae de América del Sur by Xavier Cornejo, Hugh H. Iltis, and A. Spencer Tomb—**2(1):**61

Annotated checklist of the vascular flora of the Beech Creek Unit of the Big Thicket National Preserve, Tyler County, Texas by Larry E. Brown, Barbara R. MacRoberts, Michael H. MacRoberts, Paul A. Harcombe, Warren W. Pruess, I. Sandra Elsik, and Suzanne Birmingham Walker—**2(1):**651

Annotated checklist of the vascular flora of the Loblolly Unit of the Big Thicket National Preserve, Liberty County, Texas by Larry E. Brown, Barbara R. MacRoberts, Michael H. MacRoberts, Warren W. Pruess, I. Sandra Elsik, and Suzanne Birmingham Walker—**2(2):**1481

Annotated vascular flora of the Dead Horse Mountains, Big Bend National Park, Texas, with notes on local vegetation communities and regional floristic relationships by Joselyn Fenstermacher, A. Michael Powell, Joe Sirotnak, and Martin Terry—**2(1):**685

Aphanelytrum peruvianum (Poaceae: Poinae): a new species from Peru by Isidoro Sánchez Vega, Paul M. Peterson, Robert J. Soreng, and Simon Lægaard—**1(2):**841

Araucarian source of fossiliferous Burmese amber: spectroscopic and anatomical evidence by George Poinar, Jr., Joseph B. Lambert, and Yuyang Wu—**1(1):**449

Aristidae eludendae II: a re-evaluation of the **Aristida gibbosa** complex (Poaceae: Aristideae), including **A. mar-**

J. Bot. Res. Inst. Texas 2(2): 1501 – 1506. 2008

ginalis, A. orizabensis, and **A. sorzogonensis** by Robert T. Strahan and Kelly W. Allred—**2(1):**309

Aristolochia schultzeana (Aristolochiaceae) new to Ecuador by Douglas H. Goldman—**2(2):**1337

Asclepiadoidea (Apocynaceae) como maleza en el cultivo del agave tequilero (**Agave tequilana** var. **"azul"**) by Irma López-Muraira, Rubén Iruegas, Isaac Andrade González y Juan Florencio Gómez Leyva—**2(2):**1341

Asclepias hirtella (Apocynaceae) newly documented for the flora of Texas by Matt White—**2(2):**1495

Assessment of plant biodiversity in Wechiau Community Hippopotamus Sanctuary in Ghana by Alex Asase and Alfred A. Oteng-Yeboah—**1(1):**549

Boerhavia triquetra var. **intermedia** (Nyctaginaceae); a new combination and varietal status for the widespread southwestern North American **B. intermedia** by Richard Spellenberg—**1(2):**871

Botanical composition and multivariate analysis of vegetation on the Pothowar Plateau, Pakistan by Altaf A. Dasti, Shehzadi Saima, Mohammad Athar, Attiq-ur-Rahman, and Saeed A. Malik—**1(1):**557

Bouteloua (Poaceae: Chloridoideae: Cynodonteae: Boutelouinae) del noreste de México by Yolanda Herrera Arrieta, Paul M. Peterson y Jesus Valdés-Reyna—**2(2):**917

Carex breviculmis (Cyperaceae), new to the flora of North America by Lucas C. Majure and Charles T. Bryson—**2(2):**1381

Caryophyllaceae in North America: change over the last 110 years by Richard K. Rabeler and Ronald L. Hartman—**2(2):**1285

Checklist of the vascular plants of Crawford County, Pennsylvania by Cynthia M. Morton, Loree Speedy, and James K. Bissell—**1(1):**631

Checklist of the vascular plants of Fayette County, Pennsylvania by Cynthia M. Morton and Loree Speedy—**2(2):**1449

Checklist of the vascular plants of Washington County, Pennsylvania by Cynthia M. Morton and Loree Speedy—**1(2):**1229

Chromosome number of **Laubertia contorta** (Apocynaceae: Apocynoideae) and its phylogenetic importance by Justin K. Williams and Dawn P. Derr—**1(1):**431

Chromosome number of **Thevetia ahouai** (Apocynaceae: Rauvolfoidae: Plumerieae) with discussion on the generic boundaries of Thevetia by Justin K. Williams and Julia K. Stutzman—**2(1):**489

Chromosome numbers for southwestern North American species of **Antennaria** (Asteraceae: Gnaphalieae) by Jerry G. Chmielewski—**2(1):**487

Cinco nuevas especies de **Pilea** (Urticaceae) de Costa Rica by Alexander Rodríguez y Alexandre K. Monro—**2(2):**995

Clarification of **Borreria gymnocephala, Diodia gymnocephala, Diodia schumannii, Borreria flavovirens,** and **Spermacoce schumannii** (Rubiaceae) by Piero G. Delprete and Joseph H. Kirkbride, Jr. —**2(1):**305

Contributions to the genus **Festuca** (Poaceae: Poeae) in Mexico and a key to the Central American species by Stephen J. Darbyshire—**1(2):**827

Correct basionym and combination for **Pappostipa barrancaensis** (Poaceae) by Konstantyn Romaschenko—**2(2):**1233

Cotyledon areoles in the Fabaceae subtribe Clitoriinae by James A. Lackey—**1(2):**1101

Cretacifilix fungiformis gen. and sp. nov., an eupolypod fern (Polypodiales) in Early Cretaceous Burmese amber by George O. Poinar, Jr. and Ron Buckley—**2(2):**1175

Description of **Carex klamathensis** (Cyperaceae), a rare sedge of the Klamath Region of Oregon and California, U.S.A. by Barbara L. Wilson, Richard E. Brainerd, Lawrence P. Janeway, Keli Kuykendall, Danna Lytjen, Bruce Newhouse, Nick Otting, Stephen Meyers, and Peter F. Zika—**1(1):**69

Dicerandra modesta (Lamiaceae): raise in rank for a disjunct perennial in a new coastal clade in Florida by Robin B. Huck—**2(2):**1163

Diferencias en el uso de plantas entre hombres y mujeres en una comunidad de pie de monte del norte del Ecuador by David Suárez Duque—**2(2):**1295

Distribution and taxonomy of **Symphyotrichum sericeum** and **S. pratense** (Asteraceae: Astereae) by Ronald L. Jones, C. Theo Witsell, and Guy L. Nesom—**2(1):**731

Distribution of **Gamochaeta** (Asteraceae: Gnaphalieae) in Texas, Oklahoma, Arkansas, and Louisiana by Guy L. Nesom—**1(2):**1125

Distribution of hanging garden vegetation associations on the Colorado Plateau, USA by James F. Fowler, N.L. Stanton, and Ronald L. Hartman—**1(1):**585

Diversidad y distribución de la flora vascular acuática de Tamaulipas, México by Arturo Mora-Olivo y José Luis Villaseñor—**1(1):**511

Diversity and floristic composition of the vascular plants in the forest fragment in southeastern Rio de Janeiro, Brazil by Regina H.P. Andreata, Haroldo C. de Lima, Angela S. Fonseca Vaz, José Fernando A. Baumgratz, and Sheila R. Profice—**2(1):**575

Early historical references to the Big Thicket, Texas by Michael H. MacRoberts and Barbara R. MacRoberts—**2(1):**661

Eoëpigynia burmensis gen. and sp. nov., an Early Cretaceous eudicot flower (Angiospermae) in Burmese amber by George Poinar, Jr., Kenton L. Chambers, and Ron Buckley—**1(1):**91

Eragrostis (Poaceae: Chloridoideae: Eragrostideae) in Colombia by Paul M. Peterson and Diego Giraldo-Cañas—**2(2):**875

Estudios en las Apocynaceae Neotropicales XXX: tres nuevas especies andinas de **Mandevilla** (Apocynoideae: Mesechiteae) by J. Francisco Morales—**1(2):**853

Estudios en las Apocynaceae Neotropicales XXXI: el complejo de **Mandevilla hirsuta** y cuatro nuevas especies by J. Francisco Morales—**1(2):**859

Exotic species of **Celtis** (Cannabaceae) in the Flora of North America by Alan T. Whittemore—**2(1):**627

Five new varieties of **Agapetes** (Ericaceae) from India by D. Banik and M. Sanjappa—**1(2):**903

Floristic composition of seasonally dry tropical forest fragments in Central Bahia, northeastern Brazil by Domingos Benício Oliveira Silva Cardoso and Luciano Paganucci de Queiroz—**2(1):**551

Flow diagrams for plant succession in the Middle Tennessee cedar glades by J.M. Baskin, E. Quarterman, and C.C. Baskin—**1(2):**1131

Folia taxonomica 1. Validation of two taxa from northern South America by Christian Feuillet—**1(1):**143

Folia taxonomica 10. New species of **Nautilocalyx** (Gesneriaceae: Episcieae) from the Venezuelan Guayana by Christian Feuillet—**2(2):**825

Folia taxonomica 11. Conspectus of **Varronia** (Cordiaceae, Boraginales) in the Guiana Shield with three new combinations by Christian Feuillet—**2(2):**837

Folia taxonomica 2. New species of **Passiflora** subgenus **Passiflora** (Passifloraceae) from the Guianas by Christian Feuillet—**1(2):**819

Folia taxonomica 3. **Passiflora davidii** (Passifloraceae), a new species in subgenus **Passiflora** and a key to the sections of supersection **Stipulata** by Christian Feuillet—**1(2):**895

Folia taxonomica 4. Conspectus of **Myriopus** (Heliotropiaceae: Boraginales) in the Guiana Shield by Christian Feuillet—**2(1):**263

Folia taxonomica 5. A new name for **Passiflora heterophylla** (Passifloraceae) from Cuba and Haiti by Christian Feuillet and John M. MacDougal—**2(1):**267

Folia taxonomica 6. Two new species of **Besleria** (Gesneriaceae) from the Venezuelan Guayana by Christian Feuillet—**2(1):**269

Folia taxonomica 7. Two new species and a new section in **Episcia** (Gesneriaceae) from the Venezuelan Guayana by Christian Feuillet—**2(1):**275

Folia taxonomica 8. **Passiflora tecta** (Passifloraceae), a new species in subgenus **Passiflora** from the Guianas by Christian Feuillet—**2(1):**281

Folia taxonomica 9. New species of **Passiflora** subg. **Decaloba** (Passifloraceae) from northern South America by Christian Feuillet and John M. MacDougal—**2(2):**817

Four new combinations in **Mosiera** (Myrtaceae) from the Caribbean by Andrew Salywon—**1(2):**899

Fourteen new combinations in **Sedum** (Crassulaceae) by Hideaki Ohba—**1(2):**889

Further transfers of glandular-pubescent species from **Chenopodium** subg. **Ambrosia** to **Dysphania** (Chenopodiaceae) by Sergei L. Mosyakin and Steven E. Clemants—**2(1):**425

Galium anglicum (Rubiaceae) new for Texas and notes on the taxonomy of the **G. parisiense/divaricatum** complex by Barney L. Lipscomb and Guy L. Nesom—**1(2):**1269

Generic realignments in tribe **Potentilleae** and revision of **Drymocallis** (Rosoideae: Rosaceae) in North America by Barbara Ertter—**1(1):**46

Gutierrezia elegans sp. nov. (Asteraceae: Astereae), a shale barren endemic of southwestern Colorado by Al Schneider, Peggy Lyon, and Guy Nesom—**2(2):**771

Hawthorns (**Crataegus:** Rosaceae) of the Cypress Hills, Alberta and Saskatchewan by J.B. Phipps and R.J. O'Kennon—**1(2):**1031

Heuchera woodsiaphila (Saxifragaceae), a new species from the Capitan Mountains of New Mexico by Patrick J. Alexander—**2(1):**447

Hypericum adpressum (Clusiaceae) new to Arkansas and the Ouachita Mountains, U.S.A by C. Theo Witsell—**1(1):**713

Illicium guajaibonense, elevated to species rank and compared with the subspecies of **Illicium cubense** (Illiciaceae) by Walter S. Judd, J. Richard Abbott, and Ashley Morris—**2(2):**799

Index of names and types in West Indian Gonolobinae (Apocynaceae: Asclepiadoideae), including fourteen new lectotypifications, one neotypification, a new name, and a new combination by Alexander Krings—**2(1):**139

Infrageneric classification and nomenclatural notes for **Pycnanthemum** (Lamiaceae) by Kenton L. Chambers and Henrietta L. Chambers—**2(1):**193

Infraspecific taxonomy and nomenclature of **Eleocharis acutangula** (Cyperaceae) by David J. Rosen, Stephan L. Hatch, and Richard Carter—**1(2):**875

Inventory and distribution of **Agave** (Agavaceae) species in Jalisco, Mexico by Gerardo Hernández-Vera, Miguel Cházaro Basañez, and Ericka Flores-Berrios—**1(1):**499

Ipomoea tehuantepecensis (Convolvulaceae): a new species from the Isthmus of Tehuantepec, Mexico by Leticia Torres-Colín, Rafael Torres-Colín, Miriam P. Ramírez de Anda, and J. Andrew McDonald—**2(2):**793

James Hinton (1915–2006) by George S. Hinton and Billie L. Turner—**1(2):**1277

Juncus digitatus (Juncaceae), a new annual rush from Shasta County, California, U.S.A. by Carol W. Witham and Peter F. Zika—**2(2):**775

Kalmiopsis fragrans (Ericaceae), a new distylous species from the southern Cascade Mountains of Oregon by Robert J. Meinke and Thomas N. Kaye—**1(1):**9

Kruschke names in North American **Crataegus** (Rosaceae) by J.B. Phipps—**1(2):**1011

Kruschke names in North American **Crataegus** (Rosaceae): a correction and clarifications by J.B. Phipps—**2(1):**473

La familia Nymphaeaceae en el estado de Nuevo León, México by Carlos Velazco-Macías, Rahim Foroughbakhch Pournavab, Marco A. Alvarado Vázquez, y Glafiro J. Alanis Flores—**2(1):**593

Lasiambix dominicensis gen. and sp. nov., a eudicot flower in Dominican amber showing affinities with Fabaceae subfamily Caesalpinioideae by George O. Poinar, Jr., Kenton L. Chambers, and Alex E. Brown—**2(1):**463

Lawrence K. Magrath (1943–2007) by Barney Lipscomb —**1(1):**781

Lectotypification and notes on **Baccharis riograndensis** (Asteraceae: Astereae) by Gustavo Heiden and Angelo A. Schneider—**2(1):**291

Lectotypification of **Gaultheria pyrolifolia** and **G. pyroloides** (Ericaceae) by Peter W. Fritsch and Debra K. Trock—**1(1):**97

Lectotypification of **Maxillaria heteroclita** (Orchidaceae) by Eric A. Christenson—**1(2):**1003

Lectotypifications and new taxa in **Potentilla** sect. **Subviscosae** (Rosaceae) in Arizona by Barbara Ertter—**1(1):**47

Leptochloa (Poaceae: Chloridoideae) in Colombia by Neil Snow, Paul M. Peterson, and Diego Giraldo-Cañas—**2(2):**861

Lilaeopsis carolinensis (Apiaceae) a species new to Texas and a key to **Lilaeopsis** in Texas by Stephan L. Hatch and A. Tucker Slack—**2(2):**1497

Los encinos (**Quercus:** Fagaceae) de Coahuila, Mexico by José A. Villarreal Q., Juan A. Encina D. y Miguel A. Carranza P.—**2(2):**1278

Luziola subintegra (Poaceae: Oryzeae), new to Florida and the United States by John M. Kunzer and Michael J. Bodle—**2(1):**633

Lyonothamneae, a new tribe in the Rosaceae (Rosales) by Luc Brouillet—**2(1):**385

Meliosma antioquiensis: una nueva Sabiaceae de Colombia by Xavier Cornejo—**2(1):**57

Micranthes nelsoniana var. **porsildiana** (Saxifragaceae), the proper name at the varietal level by Luc Brouillet—**2(1):**395

Minuartia drummondii (Caryophyllaceae) and **Gratiola flava** (Plantaginaceae) rediscovered in Louisiana and **Gratiola flava** historically in Arkansas by Michael H. MacRoberts, Barbara R. MacRoberts, Christopher S. Reid, Patricia L. Faulkner, and Dwayne Estes—**1(1):**763

Minuartia macrantha (Alsinoideae: Caryophyllaceae): morphological circumscription, geographical range, and phylogenetic affinities by Ronald L. Hartman and Richard K. Rabeler—**2(2):**1225

Miscellaneous typifications, new combinations and one new variety in North American **Crataegus** (Rosaceae) by J.B. Phipps—**1(2):**1005

Molecular analysis of **Solidaster** cv. Lemore, a hybrid goldenrod (Asteraceae) by Edward E. Schilling, James B. Beck, Patrick J. Calie, and Randall L. Small—**2(1):**7

Molecular phylogenetic analysis of the American Stipeae (Poaceae) resolves **Jarava** sensu lato polyphyletic: evidence for a new genus, Pappostipa by Konstantyn Romaschenko, Paul M. Peterson, Robert J. Soreng, Nuria Garcia-Jacas, Oksana Futorna, and Alfonso Susanna—**2(1):**165

Monarda lindheimeri (Lamiaceae): new to Arkansas by Walter C. Holmes and Jason R. Singhurst—**1(1):**717

Muhlenbergiinae (Poaceae: Chloridoideae: Cynodonteae): from northeastern México by Paul M. Peterson, Jesus Valdés-Reyna, and Yolanda Herrera Arrieta—**1(2):**933

Munrochloa, a new genus (Poaceae: Bambusoideae) with a new combination from India by Muktesh Kumar and M. Remesh—**2(1):**373

Neocalyptrocalyx morii (Capparaceae), a new species from central French Guiana by Xavier Cornejo and Hugh H. Iltis—**2(2):**807

Neptunia plena (Fabaceae: Mimosoideae) rediscovered in Texas by Alfred Richardson and Ken King—**2(2):**1491

New and noteworthy records of several non-native vascular plant species in Arkansas by Brett E. Serviss and James H. Peck—**2(1):**637

New combinations and new synonymies in the genus **Spermacoce** (Rubiaceae) for the flora of Goiás and Tocantins (Brazil) and the flora of the Guianas by Piero G. Delprete—**1(2):**1023

New combinations in **Dudleya** (Crassulaceae) and **Ribes** (Grossulariaceae) by Nancy R. Morin—**1(2):**1015

New combinations in **Limnanthes** (Limnanthaceae) by Nancy R. Morin—**1(2):**1017

New combinations in **Micranthes** (a segregate of **Saxifraga,** Saxifragaceae) in North America by Luc Brouillet and Richard Gornall—**1(2):**1019

New combinations in **Philadelphus** (Philadelphaceae) by James Henrickson—**1(2):**901

New combinations in the Panarctic vascular plant flora by Reidar Elven and David F. Murray—**2(1):**433

New names for bamboos of Nepal (Poaceae: Bambusoideae) by C.M.A. Stapleton—**1(1):**135

New plant discoveries for Sonoran Islands, Gulf of California, Mexico by Benjamin T. Wilder, Richard S. Felger, Humberto Romero-Morales, and Adrián Quijada-Mascareñas—**1(2):**1203

New records of **Poa** (Poaceae) and **Poa pfisteri:** a new species endemic to Chile by Robert J. Soreng and Paul M. Peterson—**2(2):**847

New records of wetland and riparian plants in southern California, with recommendations and additions to the National List of Plant Species that Occur in Wetlands by Richard E. Riefner, Jr. and Steve Boyd—**1(1):**719

New species of Myrtaceae from Ecuador by Bruce K. Holst and Maria Lúcia Kawasaki—**2(1):**297

New, corrected, and interesting records for the Kansas vascular flora by Caleb A. Morse, Craig C. Freeman, and Ronald L. McGregor—**1(1):**753

Nomenclatural changes in **Nemacladus** (Campanulaceae) by Nancy R. Morin—**2(1):**397

Nomenclatural notes in North American **Potentilla** (Rosaceae) by Barbara Ertter—**2(1):**201

Notes on **Conocarpus erectus** (Combretaceae) in the Baja California Peninsula, Mexico by José Luis León-de la Luz and Raymundo Domínguez-Cadena—**1(1):**487

Notes on **Lechea maritima** var. **virginica** (Cistaceae) by Bruce A. Sorrie and Alan S. Weakley—**1(1):**367

Notes on **Phragmites australis** (Poaceae: Arundinoideae) in North America by Kristin Saltonstall and Donald Hauber—**1(1):**385

Notes on Texas orchids (Orchidaceae) by Paul Martin Brown—**1(2):**1265

Notes on the disarticulation of **Xylothamia** (Asteraceae: Astereae) by Guy L. Nesom—**1(1):**145

Notes on the flora of Texas with additions and other significant records. III by Larry E. Brown, Eric L. Keith, David J. Rosen, and Joe Liggio—**1(2):**1255

Notes on the **Gaylussacia dumosa** complex (Ericaceae) by Bruce A. Sorrie and Alan S. Weakley—**1(1):**333

Noteworthy collections from the southeastern United States by Bruce A. Sorrie and Richard J. LeBlond—**2(2):**1353

Noteworthy collections from the Yazoo-Mississippi Delta Region of Mississippi by Daniel A. Skojac, Jr., Charles T. Bryson, and Charles H. Walker II—**1(1):**769

Noteworthy plants from north Florida. VIII by Loran C. Anderson—**1(1):**741

Noteworthy vascular plant collections from northwest Louisiana by Christopher S. Reid, Patricia L. Faulkner, Barbara R. MacRoberts, and Michael H. MacRoberts—**2(1):**643

Novae Gesneriaceae neotropicarum XV: **Kohleria hypertrichosa,** a new species of Gesneriaceae from northwestern Ecuador by John Littner Clark and Laurence E. Skog—**2(1):**19

Observation on vegetation changes in Cajun Prairie, a coastal prairie flora in southwest Louisiana by Charles Allen and Sara Thames—**1(2):**1141

Paspalum vaginatum (Poaceae), a new threat to wetland diversity in southern California by Richard E. Riefner, Jr. and J. Travis Columbus—**2(1):**743

Phylogenetic analyses of the genus **Baptistonia** (Orchidaceae: Oncidiinae) sensu lato based on morphological characters by Guy R. Chiron—**1(2):**913

Phylogenetic analysis of North American plums (**Prunus** sect. Prunocerasus: Rosaceae) based on nuclear *LEAFY* and *s6pdh* sequences by Joseph R. Rohrer, Megan A. O'Brien, and Julie A. Anderson—**2(1):**401

Phytogeography of the Big Thicket, East Texas by Michael H. MacRoberts and Barbara R. MacRoberts—**1(2):**1149

Praxelis clematidea (Asteraceae), a genus and species new for the flora of North America by J. Richard Abbott, C. LeAnn White, and S. Barry Davis—**2(1):**621

Predicting **Viola guadalupensis** (Violaceae) habitat in the Guadalupe Mountains using GIS: evidence of a new isolated population by Timothy C. Mullet, Fred Armstrong, Benjamin Zank, and Christopher M. Ritzi—**2(1):**677

Ranunculus ficaria (Ranunculaceae), naturalized in Texas by Guy L. Nesom—**2(1):**741

Rare and endemic plants of the Big Thicket: a phytogeographical analysis by Michael H. MacRoberts and Barbara R. MacRoberts—**2(2):**1475

Recognition of **Lechea pulchella** var. **ramosissima** (Cistaceae) by Bruce A. Sorrie and Alan S. Weakley—**1(1):**369

Recognition of three taxa of eastern North American "**Waldsteinia**" and their appropriate names when incorporated into **Geum** (Colurieae: Rosaceae) by Alan S. Weakley and Kanchi N. Gandhi—**2(1):**414

Redescubrimiento de **Axiniphyllum sagittalobum** (Asteraceae) en la Sierra Madre del sur y notas de las especies de este género que habitan en el estado de Guerrero, México by Alberto González-Zamora, Isolda Luna-Vega, y José Luis Villaseñor—**1(1):**491

Re-discovery and typification of **Thibaudia laurifolia, Macleania insignis,** and **M. coccinea** (Ericaceae: Vaccinieae), an adventurous history by James L. Luteyn—**2(1):**243

Rediscovery of **Eleocharis kleinii** (Cyperaceae), an overlooked species from the highlands of South Brazil by R. Trevisan, D.J. Rosen, and I.I. Boldrini—**1(2):**1119

Rediscovery of **Mirabilis hintoniorum** (Nyctaginaceae), a striking four-o'clock endemic to the Sierra de Coalcomán, Michoacán, México by Mark Fishbein and Victor W. Steinmann—**2(1):**547

Re-examination of **Muhlenbergia capillaris, M. expansa,** and **M. sericea** (Poaceae: Muhlenbergiinae) by Danny J. Gustafson and Paul M. Peterson—**1(1):**85

Refugio de fitodiversidad en la ciudad de México, el caso de la cuenca del río Magdalena by V. Ávila-Akerberg, B. González-Hidalgo, M. Nava-López y L. Almeida-Leñero—**2(1):**605

Reinstatement of **Sagittaria macrocarpa** (Alismataceae) by Bruce A. Sorrie, Brian R. Keener, and Adrienne L. Edwards—**1(1):**345

Relationships of **Houstonia prostrata** (Rubiaceae) of Mexico and Arizona and a review of **Houstonia** subgenera and sections by Edward E. Terrell—**1(1):**109

Review of **Crataegus** series **Apricae,** ser. nov., and **C. flava** (Rosaceae) by J.B. Phipps and K.A. Dvorsky—**1(1):**171

Revision of **Gonolobus** s.s. (Apocynaceae: Asclepiadoideae) in the West Indies by Alexander Krings—**2(1):**95

Revision of **Lobelia** sect. **Galeatella** (Campanulaceae: Lobelioideae) by Thomas G. Lammers—**1(2):**789

Revision of **Siphonandra** (Ericaceae: Vaccinieae), a genus endemic to Peru and Bolivia by James L. Luteyn and Edgardo M. Ortiz—**2(1):**249

Revision of **Tocoyena** (Rubiaceae: Gardenieae) from the states of Goiás and Tocantins and a new species endemic to white-sand areas in the Brazilian Cerrado by Piero G. Delprete—**2(2):**983

Saxifraga texana (Saxifragaceae) new to Louisiana by Christopher S. Reid, Patricia L. Faulkner, Barbara R. MacRoberts, and Michael H. MacRoberts—**1(2):**1251

Seed and capsule morphology in six genera of Hedyotideae (Rubiaceae): **Thecagonum, Neanotis, Dentella, Kohautia, Pentodon,** and **Oldenlandiopsis** by Edward E. Terrell and Harold Robinson—**1(1):**373

Seed dispersal and soil seed bank of **Seriphidium quettense** (Asteraceae) in Highland Balochistan, Pakistan by Sarfraz Ahmad, Shamim Gul, Muhammad Islam, and Mohammad Athar—**1(1):**569

Seed germination response of **Zizania texana** (Poaceae: Oryzae) to soil inundation by M.L. Alexander—**2(1):**673

Senecio cymbalarioides, S. subnudus, and **S. subpeltatus,** history of a muddle (Asteraceae: Senecioneae) by J.F. Veldkamp—**2(2):**1215

Silene flos-cuculi ssp. **flos-cuculi** (Caryophyllaceae) and **Euphorbia peplus** (Euphorbiaceae), new to North Carolina by Derick B. Poindexter—**2(1):**649

Species richness of vegetational areas of Texas: a first approximation by Michael H. MacRoberts and Barbara R. MacRoberts—**2(2):**1373

Status of **Schoenoplectus hallii** (Hall's bulrush) (Cyperaceae) in the United States by Paul M. McKenzie, S. Galen Smith, and Marian Smith—**1(1):**457

Structure and diversity of a riparian forest at Kaieteur National Park, Guyana by Carol L. Kelloff—**2(1):**521

Talinum rugospermum (Portulacaceae) new to Oklahoma by Christopher S. Reid, Patricia L. Faulkner, Barbara R. MacRoberts, and Michael H. MacRoberts—**1(1):**777

Taxonomic overview of the **Heterotheca fulcrata** complex (Asteraceae: Astereae) by Guy L. Nesom—**1(1):**21

Taxonomy and nomenclature of **Taxus** (Taxaceae) by Richard W. Spjut—**1(1):**203

Taxonomy of **Bromus** (Poaceae: Pooideae: Bromeae) sections **Bromopsis, Bromus,** and **Genea** in British Columbia, Canada by Jeffery M. Saarela—**2(1):**323

Tetrazygia paralongicollis (Miconieae: Melastomataceae), a new species from the Sierra de Baoruco and Sierra Martin

Garcia, Dominican Republic by Walter S. Judd, Gretchen M. Ionta, Teodoro Clase, and J. Dan Skean, Jr. —**2(1):**35
The Big Thicket of Texas as floristically unique habitat by Michael H. MacRoberts and Barbara R. MacRoberts—**2(1):**665
The Big Thicket: pristine wilderness or archeologically understudied? by Michael H. MacRoberts and Barbara R. MacRoberts—**2(2):**1291
The Cactaceae of the Natural Municipal Park of Prainha, Rio de Janeiro, Brazil: taxonomy and conservation by Alice de Moraes Calvente and Regina Helena Potsch Andreata—**1(1):**529
The **Diospyros salicifolia** complex (Ebenaceae) in Mesoamerica by Mitchell C. Provance, Ignacio García Ruiz, and Andrew C. Sanders—**2(2):**1009
The genus **Abronia** (Nyctaginaceae) in Colorado, with notes on **Abronia bolackii** in New Mexico by Jennifer Ackerfield and William F. Jennings—**2(1):**419
The identity of cultivated **Phellodendron** (Rutaceae) in North America by Jinshuang Ma and Anthony R. Brach—**1(1):**357
The species of **Fumaria** (Papaveraceae) in Texas, including **F. densiflora,** first records from North America by Monique Reed, Richard V. Lansdown, and Tim C.G. Rich—**2(2):**1347
The taxonomy of **Carex trisperma** (Cyperaceae) by Chad D. Kirschbaum—**1(1):**389
The taxonomy of North American loti (Fabaceae: Loteae): new names in **Acmispon** and **Hosackia** by Luc Brouillet—**2(1):**387
The vascular flora of a woodland park site in east Harris County, Texas by P.A. Harcombe, I.S. Elsik, W.W. Pruess, and L.E. Brown—**1(1):**693
The vascular flora of Nash Prairie: a Coastal Prairie remnant in Brazoria County, Texas by David J. Rosen—**1(1):**679
The vascular flora of the Chunky River (Mississippi) by Lucas C. Majure—**1(2):**1179
The vascular flora of the Hancock Biological Station, Murray State University, Calloway County, Kentucky by Ralph L. Thompson—**1(1):**609
The vascular flora of three abandoned rice fields, Georgetown, South Carolina: a 39 year comparison by Richard Stalter, John Baden, and Dwight Kincaid—**1(1):**665
The world's smallest bamboo: **Raddiella vanessiae** (Poaceae: Bambusoideae: Olyreae), a new species from French Guiana by Emmet J. Judziewicz and Sol Sepsenwol—**1(1):**1
Thomas Walter Typification Project, II: the known Walter types by Daniel B. Ward—**1(1):**407
Thomas Walter Typification Project, III: lectotypes and neotypes for 20 Walter names, as recognized in the Fraser/Walter herbarium by Daniel B. Ward—**1(1):**425
Thomas Walter Typification Project, IV: neotypes and epitypes for 43 Walter names of genera A through C by Daniel B. Ward—**1(2):**1091
Thomas Walter Typification Project, V: neotypes and epitypes for 63 Walter names of genera D through Z by Daniel B. Ward—**2(1):**475
Thomas Walter Typification Project, VI: neotypes for an additional 18 Walter names by Daniel B. Ward—**2(2):**1279
Three new names in the Caribbean flora by Alain H. Liogier—**2(2):**1165
Three new species of **Ixora** (Rubiaceae) from the state of Tocantins, Brazil by Piero G. Delprete—**2(1):**455
Tree canopy research and student experiences using the doubled rope climbing method by Courtney M. Kilgore, Harold W. Keller, Sydney E. Everhart, Angela R. Scarborough, Kenneth L. Snell, Melissa S. Skrabal, Charly Pottorff, and Joseph S. Ely—**2(2):**1309
Trochanthera lepidota gen. and sp. nov., a fossil angiosperm inflorescence in Dominican amber by George O. Poinar, Jr., Kenton L. Chambers, and Alex E. Brown—**2(2):**1167
Two new **Cotoneasters** (Cotoneaster: Rosaceae) from Yunnan Province, China by Jeanette Fryer and Bertil Hylmöt—**2(1):**53
Two new species of **Baccharis** sect. **Caulopterae** (Asteraceae: Astereae) from southern Brazil by Angelo Alberto Schneider and Ilsi Iob Boldrini—**2(1):**45
Two new species of Cyperaceae from Peninsular India by M.A. Wadood Khan and P. Lakshminarasimhan—**2(1):**379
Two new species of **Gratiola** (Plantaginaceae) from eastern North America and an updated circumscription for **Gratiola neglecta** by Dwayne Estes and Randall L. Small—**1(1):**149
Two new species of **Guadua** (Bambusoideae: Guaduinae) from Colombia and Bolivia by Ximena Londoño and Eneida Zurita—**2(1):**25
Two new subspecies of **Sidalcea hickmanii** (Malvaceae) in California by Steven R. Hill—**2(2):**783

Una nueva especie de **Agave,** subgenero **Littaea** (Agavaceae) de Tamaulipas, México by Abisaí García-Mendoza, Cuauhtémoc Jacques-Hernández y Ángel Salazar Bravo—**1(1):**79
Una nueva especie de **Cuatresia** (Solanaceae) de Costa Rica y Panamá by D. Armando Soto and A.K. Monro—**2(1):**41
Understanding **Oligactis** (Asteraceae: Liabeae): the true identity of **O. sessiliflora** and **O. volubilis** by Diego G. Gutiérrez—**2(2):**1207

Variation in **Petradoria pumila** (Asteraceae: Astereae) by Guy L. Nesom and Caleb A. Morse—**1(1):**351
Vascular flora of C. Bickham-Dickson/Red River Education and Research Park, Caddo Parish, Louisiana: an oxbow lake community, with comments on exotic/native species ratios by Michael H. MacRoberts, Barbara R. MacRoberts, and Gary M. Hanson—**2(2):**1389
Vascular flora of the Four Canyons Preserve, Ellis County, Oklahoma by Bruce W. Hoagland and Amy K. Buthod—**1(1):**655
Vascular plant species/area relationships (species richness) in the West Gulf Coastal Plain: a first approximation by Michael H. MacRoberts, Barbara R. MacRoberts, and Robert G. Kalinsky—**1(1):**577
Vascular plant type specimens in the University of British Columbia Herbarium (UBC) by Jeffery M. Saarela, Linda Lipsen, Cindy M. Sayre, and Jeannette Whitton—**1(1):**437
Vicia lathyroides (Fabaceae): new to the flora of Texas by Sonnia Hill, Ruth Loper, Jason R. Singhurst, and Walter C. Holmes—**1(2):**1253

Xyris panacea (Xyridaceae)—a new yellow-eyed grass from the Florida panhandle by Loran C. Anderson and Robert Kral—**2(1):**1

INDEX OF 324 AUTHORS:
VOLUME 1 (2007) AND VOLUME 2(2008)

Thank you for choosing *Journal of the Botanical Research Institute of Texas.*

Abbott, J. Richard—**2(1)**:621; **2(2)**:799
Ackerfield, Jennifer—**2(1)**:419
Ahmad, Sarfraz—**1(1)**:569
Alanis Flores, Glafiro J.—**2(1)**:593
Alexander, M.L.—**2(1)**:673
Alexander, Patrick J.—**2(1)**:447
Allen, Charles—**1(2)**:1141
Allred, Kelly W.—**2(1)**:309
Almeida-Leñero, L.—**2(1)**:605
Alvarado Vázquez, Marco A.—**2(1)**:593
Anderson, Julie A.—**2(1)**:401
Anderson, Loran C.—**1(1)**:741; **2(1)**:1
Andreata, Regina Helena Potsch—**1(1)**:529; **2(1)**:575
Armstrong, Fred—**2(1)**:677
Asase, Alex—**1(1)**:549
Athar, Mohammad—**1(1)**:557, 569
Ávila-Akerberg, V.—**2(1)**:605

Baden, John—**1(1)**:665
Banik, D.—**1(2)**:903
Basañez, Miguel Cházaro—**1(1)**:499
Baskin, C.C.—**1(2)**:1131
Baskin, J.M.—**1(2)**:1131
Baumgratz, José Fernando A.—**2(1)**:575
Beck, James B.—**2(1)**:7
Bissell, James K.—**1(1)**:631
Bodle, Michael J.—**2(1)**:633
Boldrini, Ilsi Iob—**1(2)**:1119; **2(1)**:45
Boyd, Steve—**1(1)**:719
Brach, Anthony R.—**1(1)**:357
Brainerd, Richard E.—**1(1)**:69
Bravo, Ángel Salazar—**1(1)**:79
Brouillet, Luc—**1(2)**:1019; **2(1)**:385, 387, 395
Brown, Alex E.—**2(1)**:463; **2(2)**:1167
Brown, Larry E.—**1(1)**:693; **1(2)**:1255; **2(1)**: 651; **2(2)**:1481
Brown, Paul Martin—**1(2)**:1265
Bryson, Charles T.—**1(1)**:769; **2(1)**:517; **2(2)**:1381
Buckley, Ron—**1(1)**:91; **2(2)**:1175, 1183
Bush, Catherine M.—**2(2)**:1193
Buthod, Amy K.—**1(1)**:655

Calie, Patrick J.—**2(1)**:7
Calvente, Alice de Moraes—**1(1)**:529
Cardoso, Domingos Benício Oliveira Silva—**2(1)**:551
Carranza P., Miguel A.—**2(2)**:1278
Carter, Richard—**1(1)**:779; **1(2)**:875; **2(1)**:517
Chambers, Henrietta L.—**2(1)**:193
Chambers, Kenton L.—**1(1)**:91; **2(1)**:193, 463; **2(2)**:1167, 1183
Chiron, Guy R.—**1(2)**:913
Chmielewski, Jerry G.—**2(1)**:487
Christenson, Eric A.—**1(2)**:1001, 1003; **2(1)**:285
Clark, John Littner—**2(1)**:19
Clark, Lynn G.—**1(2)**:847
Clase, Teodoro—**2(1)**:35
Clemants, Steven E.—**2(1)**:425
Columbus, J. Travis—**2(1)**:743
Cornejo, Xavier—**2(1)**:57, 61, 75; **2(2)**:807

Darbyshire, Stephen J.—**1(2)**:827
Dasti, Altaf A.—**1(1)**:557
Davenport, L.J.—**1(1)**:103
Davis, S. Barry—**2(1)**:621
Debelica, Anica—**2(2)**:1363
Delprete, Piero G.—**1(2)**:1023; **2(1)**:305, 455; **2(2)**:983
Derr, Dawn P.—**1(1)**:431
Domínguez-Cadena, Raymundo—**1(1)**:487
Duque, David Suárez—**2(2)**:1295
Dvorsky, K.A.—**1(1)**:171; **2(2)**:1101

Edwards, Adrienne L.—**1(1)**:345
Elsik, I. Sandra—**1(1)**:693; **2(1)**:651; **2(2)**:1481
Elven, Reidar—**1(2)**:811; **2(1)**:433
Ely, Joseph S.—**2(2)**:1309
Encina D., Juan A.—**2(2)**:1278
Ertter, Barbara—**1(1)**:46, 47; **2(1)**:201
Estes, Dwayne—**1(1)**:149, 763
Everhart, Sydney E.—**2(2)**:1309

Faulkner, Patricia L.—**1(1)**:763, 777; **1(2)**:1251; **2(1)**:643
Felger, Richard S.—**1(2)**:1203
Fenstermacher, Joselyn—**2(1)**:685
Ferreira, Silvana C.—**2(2)**:811
Feuillet, Christian—**1(1)**:143; **1(2)**:819, 895; **2(1)**:263, 267, 269, 275, 281; **2(2)**:817, 825, 837
Fishbein, Mark—**2(1)**:547
Fisher, Amanda E.—**1(2)**:847
Flores-Berrios, Ericka—**1(1)**:499
Fonseca Vaz, Angela S.—**2(1)**:575
Fowler, James F.—**1(1)**:585
Freeman, Craig C.—**1(1)**:753
Fritsch, Peter W.—**1(1)**:97
Fryer, Jeanette—**2(1)**:53
Futorna, Oksana—**2(1)**:165

Gandhi, Kanchi N.—**2(1)**:414
Garcia-Jacas, Nuria—**2(1)**:165
Garcia-Mendoza, Abisaí—**1(1)**:79
George, Satheesh—**1(1)**:121
Giannasi, David E.—**1(2)**:1157
Giraldo-Cañas, Diego—**2(2)**:861, 875
Goldman, Douglas H.—**2(2)**:1337
Gómez Leyva, Juan Florencio—**2(2)**:1341
Gómez-Sánchez, Maricela—**2(1)**:495
González, Isaac Andrade—**2(2)**:1341
González-Hidalgo, B.—**2(1)**:605
González-Zamora, Alberto—**1(1)**:491
Gornall, Richard—**1(2)**:1019
Gul, Shamim—**1(1)**:569
Gustafson, Danny J.—**1(1)**:85
Gutiérrez, Diego G.—**2(2)**:1207

Hanson, Gary M.—**2(2)**:1389
Harcombe, Paul A.—**1(1)**:693; **2(1)**:651
Hartman, Ronald L.—**1(1)**:585; **2(2)**:1225, 1285
Hatch, Stephan L.—**1(2)**:875; **2(2)**:1497
Hauber, Donald—**1(1)**:385
Hazlett, Donald L.—**2(2)**:1407
Heiden, Gustavo—**2(1)**:291
Henrickson, James—**1(2)**:901
Hernández-Vera, Gerardo—**1(1)**:499
Herrera Arrieta, Yolanda—**1(2)**:933; **2(2)**:917
Hill, Sonnia—**1(2)**:1253
Hill, Steven R.—**2(2)**:783
Hinton, George S.—**1(2)**:1277
Hoagland, Bruce W.—**1(1)**:655
Holmes, Walter C.—**1(1)**:717; **1(2)**:1253
Holst, Bruce K.—**2(1)**:297
Huck, Robin B.—**2(2)**:1163
Hylmö, Bertil—**2(1)**:53

Iltis, Hugh H.—**2(1)**:61, 75; **2(2)**:807
Ionta, Gretchen M.—**2(1)**:35
Iruegas, Rubén—**2(2)**:1341
Islam, Muhammad—**1(1)**:569

Jacques-Hernandez, Cuauhtémoc—**1(1)**:79
Janarthanam, M.K.—**1(1)**:129
Janeway, Lawrence P.—**1(1)**:69
Jennings, William F.—**2(1)**:419
Jhangiani, Shalini N.—**2(2)**:1219
Jones, Ronald L.—**2(1)**:731
Judd, Walter S.—**1(2)**:1157; **2(1)**:35; **2(2)**:799
Judziewicz, Emmet J.—**1(1)**:1

Kalinsky, Robert G.—**1(1)**:577
Kawasaki, Maria Lúcia—**2(1)**:297
Kaye, Thomas N.—**1(1)**:9
Keener, Brian R.—**1(1)**:103, 345
Keith, Eric L.—**1(2)**:1255
Keller, Harold W.—**2(2)**:1309
Kelloff, Carol L.—**2(1)**:521
Khan, M.A. Wadood—**2(1)**:379
Kilgore, Courtney M.—**2(2)**:1309
Kincaid, Dwight—**1(1)**:665
King, Ken—**2(2)**:1491
Kirkbride Jr., Joseph H.—**2(1)**:305
Kirschbaum, Chad D.—**1(1)**:389
Kral, Robert—**2(1)**:1
Krings, Alexander—**2(1)**:95, 139
Kron, Kathleen A.—**2(2)**:1193
Kumar, Muktesh—**2(1)**:373
Kunzer, John M.—**2(1)**:633
Kuykendall, Keli—**1(1)**:69

Lackey, James A.—**1(2)**:1101
Lægaard, Simon—**1(2)**:841

J. Bot. Res. Inst. Texas 2(2): 1507 – 1508. 2008

Lakshminarasimhan, P.—**2(1)**:379
Lambert, Joseph B.—**1(1)**:449
Lammers, Thomas G.—**1(2)**:789
Lansdown, Richard V.—**2(2)**:1347
LeBlond, Richard J.—**2(2)**:1353
León-de la Luz, José Luis—**1(1)**:487
Liggio, Joe—**1(2)**:1255
de Lima, Haroldo C.—**2(1)**:575
Liogier, Alain H.—**2(2)**:1165
Lipscomb, Barney L.—**1(1)**:781; **1(2)**:1269
Lipsen, Linda—**1(1)**:437
Londoño, Ximena—**2(1)**:25
Loper, Ruth—**1(2)**:1253
López-Muraira, Irma—**2(2)**:1341
Luna-Vega, Isolda—**1(1)**:491
Luteyn, James L.—**2(1)**:207, 243, 249
Lyon, Peggy—**2(2)**:771
Lytjen, Danna—**1(1)**:69

Ma, Jinshuang—**1(1)**:357
MacDougal, John M.—**2(2)**:817
MacRoberts, Barbara R.—**1(1)**:577, 763, 777; **1(2)**:1149, 1251; **2(1)**:643, 651, 661, 665; **2(2)**:1291, 1373, 1389, 1475, 1481
MacRoberts, Michael H.—**1(1)**:577, 763, 777; **1(2)**:1149, 1251; **2(1)**:643, 651, 661, 665; **2(2)**:1291, 1373, 1389, 1475, 1481
Madulid, Domingo A.—**1(2)**:815
Majure, Lucas C.—**1(2)**:1179; **2(2)**:1381
Malik, Saeed A.—**1(1)**:557
Mauz, Kathryn—**1(1)**:483
McDonald, J. Andrew—**2(2)**:793
McGregor, Ronald L.—**1(1)**:753
McKenzie, Paul M.—**1(1)**:457
Medecilo, Melanie P.—**1(2)**:815
Meinke, Robert J.—**1(1)**:9
Meyers, Stephen—**1(1)**:69
Monro, A.K.—**2(1)**:41; **2(2)**:995
Morales, J. Francisco—**1(2)**:853, 859
Mora-Olivo, Arturo—**1(1)**:511
Morin, Nancy R.—**1(2)**:1015, 1017; **2(1)**:397
Morris, Ashley—**2(2)**:799
Morse, Caleb A.—**1(1)**:351, 753
Morton, Cynthia M.—**1(1)**:631; **1(2)**:1229; **2(2)**:1449
Mosyakin, Sergei L.—**2(1)**:425
Mullet, Timothy C.—**2(1)**:677
Murray, David F.—**1(2)**:811; **2(1)**:433

Nava-López, M.—**2(1)**:605
Nelson, John B.—**2(2)**:761
Nesom, Guy L.—**1(1)**:21, 145, 351; **1(2)**:891, 1125, 1269; **2(1)**:731, 741; **2(2)**:771
Newhouse, Bruce—**1(1)**:69

O'Brien, Megan A.—**2(1)**:401
O'Kennon, R.J.—**1(2)**:1031
Ohba, Hideaki—**1(2)**:889
Ortiz, Edgardo M.—**2(1)**:249
Oteng-Yeboah, Alfred A.—**1(1)**:549
Otting, Nick—**1(1)**:69

Peck, James H.—**2(1)**:637
Peterson, Paul M.—**1(1)**:85; **1(2)**:841, 933; **2(1)**:165; **2(2)**:847, 861, 875, 917
Phipps, J.B.—**1(1)**:171; **1(2)**:1005, 1011, 1031; **2(1)**:473; **2(2)**:1101
Poinar Jr., George O.—**1(1)**:91, 449; **2(1)**:463; **2(2)**:1167, 1175, 1183
Poindexter, Derick B.—**2(1)**:649
Pottorff, Charly—**2(2)**:1309
Pournavab, Rahim Foroughbakhch—**2(1)**:593
Powell, A. Michael—**2(1)**:685
Pratt, Donald B.—**2(2)**:1219
Profice, Sheila R.—**2(1)**:575
Provance, Mitchell C.—**2(2)**:1009
Pruess, Warren W.—**1(1)**:693; **2(1)**:651; **2(2)**:1481

Quarterman, E.—**1(2)**:1131
de Queiroz, Luciano Paganucci—**2(1)**:551
Quijada-Mascareñas, Adrián—**1(2)**:1203

Rabeler, Richard K.—**2(2)**:1225, 1285
Rahman, Attiq-ur—**1(1)**:557
Rajkumar, S.—**1(1)**:129
Ramírez de Anda, Miriam P.—**2(2)**:793
Reed, Monique—**2(2)**:1347
Reid, Christopher S.—**1(1)**:763, 777; **1(2)**:1251; **2(1)**:643
Remesh, M.—**2(1)**:373
Rich, Tim C.G.—**2(2)**:1347
Richardson, Alfred—**2(2)**:1491
Riefner Jr., Richard E.—**1(1)**:719; **2(1)**:743
Ritzi, Christopher M.—**2(1)**:677
Robinson, Harold—**1(1)**:373; **2(2)**:811
Rodríguez, Alexander—**2(2)**:995
Rohrer, Joseph R.—**2(1)**:401
Romaschenko, Konstantyn—**2(1)**:165; **2(2)**:1233
Romero-Morales, Humberto—**1(2)**:1203
Roque, Nádia—**2(2)**:811
Rosen, David J.—**1(1)**:679, 779; **1(2)**:875, 1119, 1255
Ruiz, Ignacio García—**2(2)**:1009

Saarela, Jeffery M.—**1(1)**:437; **2(1)**:323
Saima, Shehzadi—**1(1)**:557
Salino, Alexandre—**2(2)**:843
Saltonstall, Kristin—**1(1)**:385
Salywon, Andrew—**1(2)**:899
Sánchez Vega, Isidoro—**1(2)**:841
Sanders, Andrew C.—**2(2)**:1009
Sanjappa, M.—**1(2)**:903
Sayre, Cindy M.—**1(1)**:437
Scarborough, Angela R.—**2(2)**:1309
Schiebout, Michael H.—**2(2)**:1407
Schilling, Edward E.—**2(1)**:7
Schneider, Al—**2(2)**:771
Schneider, Angelo Alberto—**2(1)**:45, 291
Sepsenwol, Sol —**1(1)**:1
Serviss, Brett E.—**2(1)**:637
Singhurst, Jason R.—**1(1)**:717; **1(2)**:1253
Sirotnak, Joe—**2(1)**:685
Skean Jr., J. Dan—**2(1)**:35
Skog, Laurence E.—**2(1)**:19
Skojac Jr., Daniel A.—**1(1)**:769
Skrabal, Melissa S.—**2(2)**:1309
Slack, A. Tucker—**2(2)**:1497
Small, Randall L.—**1(1)**:149; **2(1)**:7
Smith, Marian—**1(1)**:457
Smith, S. Galen—**1(1)**:457
Snell, Kenneth L.—**2(2)**:1309
Snow, Neil—**2(2)**:861, 1407
Soreng, Robert J.—**1(2)**:841; **2(1)**:165; **2(2)**:847
Sorrie, Bruce A.—**1(1)**:333, 345, 367, 369; **2(2)**:1353
Soto, D. Armando—**2(1)**:41
Speedy, Loree—**1(1)**:631; **1(2)**:1229; **2(2)**:1449
Spellenberg, Richard—**1(2)**:871
Spjut, Richard W.—**1(1)**:203, 291
Stalter, Richard—**1(1)**:665
Stanton, N.L.—**1(1)**:585
Stapleton, C.M.A.—**1(1)**:135
Steinmann, Victor W.—**2(1)**:547
Strahan, Robert T.—**2(1)**:309
Stutzman, Julia K.—**2(1)**:489
Susanna, Alfonso—**2(1)**:165

Téllez-Pimienta, Kathia Georgina—**2(1)**:495
Terrell, Edward E.—**1(1)**:109, 373
Terry, Martin—**2(1)**:685
Thames, Sara—**1(2)**:1141
Thompson, Ralph L.—**1(1)**:609
Tomb, A. Spencer—**2(1)**:61
Torres-Colín, Leticia—**2(2)**:793
Torres-Colín, Rafael—**2(2)**:793
Trevisan, R.—**1(2)**:1119
Triplett, Jimmy K.—**1(2)**:847
Trock, Debra K.—**1(1)**:97
Turner, Billie L.—**1(2)**:1277
Tushar, K.V.—**1(1)**:121
Tyrrell, Christopher D.—**1(2)**:847

Udayan, P.S.—**1(1)**:121

Valdés-Reyna, Jesus—**1(2)**:933; **2(2)**:917
Velazco-Macías, Carlos—**2(1)**:593
Veldkamp, J.F.—**2(2)**:1215
Villarreal Q. , José A.—**2(2)**:1278
Villaseñor, José Luis—**1(1)**:491, 511

Walker II, Charles H.—**1(1)**:769
Walker, Suzanne Birmingham—**2(1)**:651; **2(2)**:1481
Ward, Daniel B.—**1(1)**:407, 425; **1(2)**:1091; **2(1)**:475; **2(2)**:1279
Weakley, Alan S.—**1(1)**:333, 367, 369; **2(1)**:414, 621
White, C. LeAnn—**2(1)**:621
White, Matt—**2(2)**:1495
Whittemore, Alan T.—**2(1)**:627
Whitton, Jeannette—**1(1)**:437
Wiggers, Robert J.—**2(2)**:1219
Wilbur, Robert L.—**2(1)**:207
Wilder, Benjamin T.—**1(2)**:1203
Williams, Justin K.—**1(1)**:431; **2(1)**:489; **2(2)**:1363
Wilson, Barbara L.—**1(1)**:49, 69
Witham, Carol W.—**2(2)**:775
Witsell, C. Theo—**1(1)**:713; **2(1)**:731
Wu, Yuyang—**1(1)**:449

Yao, George C.—**1(2)**:815

Zank, Benjamin—**2(1)**:677
Zika, Peter F.—**1(1)**:69; **2(2)**:775
Zomlefer, Wendy B.—**1(2)**:1157
Zurita, Eneida—**2(1)**:25

BOTANICAL NAMES AND SUBJECT INDEX: VOLUME 1 (2007) AND VOLUME 2 (2008)

New names (454) in **bold face.**

- Abandoned rice fields—**1(1):**665
- Abronia—**2(1):**419
  - argillosa—**2(1):**419
  - bolackii—**2(1):**419
  - carletonii—**2(1):**419
  - elliptica—**2(1):**419
  - fragrans—**2(1):**419
  - glabrifolia—**2(1):**419
  - nealleyi—**2(1):**419
- Acaena elongata—**2(1):**605
- Acapulco, Mexico—**2(2):**1009
- Acer
  - negundo var. mexicanum—**2(1):**605
  - palmatum—**2(1):**637
- Achillea
  - alpina subsp. **multiflora**—**2(1):**442
  - millefolium—**2(1):**605
- Achnatherum—**2(1):**165
- Acmispon—**2(1):**387
  - americanus var. **helleri**—**2(1):**388
  - **argophyllus**—**2(1):**388
    - var. **adsurgens**—**2(1):**388
    - var. **argenteus**—**2(1):**388
    - var. **fremontii**—**2(1):**389
  - **argyreus**—**2(1):**389
    - var. **multicaulis**—**2(1):**389
    - var. **notitius**—**2(1):**389
  - **cytisoides**—**2(1):**389
  - **dendroideus**—**2(1):**389
    - var. **traskiae**—**2(1):**389
    - var. **veatchii**—**2(1):**389
  - **distichum**—**2(1):**389
  - **flexuosus**—**2(1):**389
  - **glabrus**—**2(1):**389
    - var. **brevialatus**—**2(1):**390
  - **grandiflorus**—**2(1):**390
    - var. **macranthus**—**2(1):**390
  - **greenei**—**2(1):**390
  - **haydonii**—**2(1):**390
  - **heermannii**—**2(1):**390
    - var. **orbicularis**—**2(1):**390
  - **intricatus**—**2(1):**390
  - **junceus**—**2(1):**391
    - var. **biolettii**—**2(1):**391
  - **maritimus** var. **brevivexillus**—**2(1):**391
  - **mearnsii**—**2(1):**391
    - var. **equisolensis**—**2(1):**391
  - **micranthus**—**2(1):**391
  - **nevadensis**—**2(1):**391
    - var. **davidsonii**—**2(1):**391
  - **niveus**—**2(1):**391
  - **nudatus**—**2(1):**391
  - **oroboides**—**2(1):**391
  - **procumbens**—**2(1):**392
    - var. **jepsonii**—**2(1):**392
  - **prostratus**—**2(1):**392
  - **rigidus**—**2(1):**392
  - **strigosus**—**2(1):**392
  - **utahensis**—**2(1):**392
  - **wrightii**—**2(1):**392
- Adiantum capillus-veneris Herbaceous Association—**1(1):**585
- Aegopogon—**1(2):**933, 938
- AFLP—**1(1):**389
- Africa—**1(1):**549; **2(2):**843, 1215
- Agalinis
  - divaricata—**2(2):**1353
  - filifolia—**2(2):**1353
- Agapetes—**1(2):**903
  - acuminata var. **tipiensis**—**1(2):**903
  - flava var. **nagensis**—**1(2):**905
  - megacarpa var. **lohitensis**—**1(2):**905
  - odontocera var. **mizoramensis**—**1(2):**908
  - salicifolia var. **glanduliflora**—**1(2):**910
- **Agasthiyamalaia**—**1(1):**130
  - **pauciflora**—**1(1):**131
- Agathis—**1(1):**449
- Agavaceae—**1(1):**79, 499; **2(2):**1341
- Agave—**1(1):**79, 499
  - ×glomeruliflora—**1(1):**79
  - subg. Littaea—**1(1):**79
  - Marginatae group—**1(1):**79
  - **montium-sancticaroli**—**1(1):**79
  - tequilana var. "azul"—**2(2):**1341
- Alabama, USA—**1(1):**103
- Alaska, USA—**1(1):**97
- Alberta, Canada—**1(2):**1031
- Alcatraz Island, Mexico—**1(2):**1203
- Aletris lutea—**2(2):**1353
- Alismataceae—**1(1):**345
- Alocasia—**1(2):**815
  - **nycteris**—**1(2):**817
- Alsinoideae (Caryophyllaceae)—**2(2):**1225
- Amaranthaceae—**2(2):**1219
- Amaranthus—**2(2):**1219
  - blitum—**2(1):**637
    - subsp. emarginatus—**1(1):**719
- Amazon—**2(1):**25
- Amazon Basin—**2(1):**455; **2(2):**983
- Amazonas, Venezuela—**2(1):**269, 275; **2(2):**825
- Amber—**1(1):**91, 449; **2(1):**463; **2(2):**1167, 1175, 1183
- Amphiachyris—**1(1):**145
- Anatherostipa—**2(1):**165
- Andes—**1(2):**853; **2(1):**25
- Andhra Pradesh, India—**2(1):**379
- Angiospermae—**1(1):**91
- **Anisocapparis**—**2(1):**62
  - **speciosa**—**2(1):**65
- Anotis—**1(1):**373
- Antennaria—**2(1):**487

Antilles—**2(1):**463; **2(2):**1167
Antioquia, Colombia—**2(1):**57
Aphanelytrum—**1(2):**841
  peruvianum—**1(2):**842
  procumbens—**1(2):**841, 844
Apiaceae—**2(2):**1497
Apocynaceae—**1(1):**431; **1(2):**853, 859; **2(1):**95, 139, 489; **2(2):**1341, 1495
Apocynoideae (Apocynaceae)—**1(1):**431; **1(2):**853, 859
Aquatic vascular plant diversity—**1(1):**511
Aquilegia micrantha Herbaceous Association—**1(1):**585
Arabidopsis petraea
  subsp. **septentrionalis**—**2(1):**438
  subsp. **umbrosa**—**2(1):**439
Arabis canadensis—**2(1):**643
Araceae—**1(2):**815
Araucariaceae—**1(1):**449
Archeology—**2(2):**1291
Argentina—**2(1):**61, 305; **2(2):**847
Aristida
  gibbosa—**2(1):**309
  gibbosa complex—**2(1):**309
  liebmanii—**2(1):**309
  marginalis—**2(1):**309
  orizabensis—**2(1):**309
  sorzogonensis—**2(1):**309
    f. **orizabensis**—**2(1):**322
    f. sorzogonensis—**2(1):**309
Aristideae (Poaceae)—**2(1):**309
Aristolochia—**1(1):**143
  kanukuensis—**1(1):**143
  peltato-deltoidea—**1(1):**143
  schultzeana—**2(2):**1337
Aristolochiaceae—**1(1):**143; **2(2):**1337
Arizona, USA—**1(1):**47, 109, 351, 483
Arkansas, USA—**1(1):**713, 717, 763; **1(2):**1125; **2(1):**637, 761
Artemisia kruhsiana subsp. **alaskana**—**2(1):**443
Arunachal Pradesh, India—**1(2):**903
Arundinoideae (Poaceae)—**1(1):**385
Asclepiadoideae (Apocynaceae)—**2(1):**95, 139; **2(2):**1341
Asclepias hirtella—**2(2):**1495
Asia—**1(1):**91, 97, 121, 129, 135, 291, 449, 557, 569, 903; **1(2):**815; **2(1):**53, 373, 379, 433; **2(2):**1175, 1183
Aspleniaceae—**1(1):**103
Asplenium—**1(1):**103
  ×ebenoides—**1(1):**103
  ebenoides—**1(1):**103
  tutwilerae—**1(1):**104
×Asplenosorus ebenoides—**1(1):**103
Aster—**2(1):**7
Asteraceae—**1(1):**21, 145, 351, 491, 569; **1(2):**891, 1125; **2(1):**7, 45, 291, 487, 621, 731; **2(2):**771, 811, 1207, 1215
Astereae (Asteraceae)—**1(1):**21, 145, 351; **1(2):**891; **2(1):**7, 45, 291, 731; **2(2):**771
Atheropogon acuminatus—**2(2):**917
Atlantic Coastal Plain, USA—**1(1):**577
Atlantic Coastal Ridge, Florida, USA—**2(2):**1163
Atlantic Forest, South America—**1(1):**529; **2(1):**551
Atriplex polycarpa—**1(1):**719
Austrostipa—**2(1):**165
Axiniphyllum
  corymbosun—**1(1):**491
  pinnatisectum—**1(1):**491
  sagittalobum—**1(1):**491

Baccharis
  apicifoliosa—**2(1):**45
  sect. Caulopterae—**2(1):**45
  flexuosiramosa—**2(1):**48
  milleflora—**2(1):**45
  organensis—**2(1):**45
  riograndensis—**2(1):**291
Bacopa monnieri—**1(1):**719
Bahia, Brazil—**2(1):**551; **2(2):**811, 843
Baja California Sur, Mexico—**2(2):**1009
Baja California, Mexico—**1(1):**47, 109, 486; **1(2):**871
Balanophoraceae—**2(2):**1167
Balochistan, Pakistan—**1(1):**569
Bamboo—**1(1):**1, 135; **2(1):**25, 373
Bambusa ritcheyi—**2(1):**373
Bambusoideae (Poaceae)—**1(1):**1, 135; **1(2):**847; **2(1):**25, 373
Baptistonia—**1(2):**913
Barbieria—**1(2):**1101
Barrens—**2(2):**1475
Barro Colorado Island, Panama—**2(1):**521
Bejaria—**2(2):**1193
  racemosa—**2(2):**1193
Bejarieae (Ericaceae)—**2(2):**1193
Besleria—**2(1):**269
  gibbosa sect. Neobesleria subsect. Axillares—**2(1):**269
  neblinae—**2(1):**269
  yatuana—**2(1):**271
Beta vulgaris subsp. maritima—**1(1):**719
Bifid petals—**2(1):**57
Big Bend National Park, USA—**2(1):**685
Big Thicket, Texas, USA—**1(2):**1149; **2(1):**661, 665; **2(2):**1291, 1475
Big Thicket National Preserve, USA
  Beech Creek Unit—**2(1):**651
  Loblolly Unit—**2(2):**1481
Bigelowia—**1(1):**145
Biodiversity—**2(1):**743
Bistorta **elliptica**—**2(1):**435
Blepharoneuron—**1(2):**933, 939
Blue Ridge Physiographic Province, USA—**2(1):**649
Boehler Seeps and Sandhills Preserve, Oklahoma, USA—**1(1):**777
Boerhavia
  intermedia—**1(2):**871
  triquetra—**1(2):**871
  triquetra var. **intermedia**—**1(2):**874
Bogs—**2(2):**1475
Bolívar, Venezuela—**2(2):**825
Bolivia—**2(1):**25, 61, 249
Boltonia diffusa—**2(2):**1353
Boraginales—**2(1):**263; **2(2):**837

Borinda chigar—**1(1):**135
Borreria—**1(2):**1023
    gymnocephala—**2(1):**305
Bouteloua—**2(2):**917
    burkii—**2(2):**917
    tamaulipensis—**2(2):**917, 966
Boutelouinae (Poaceae: Chloridoideae: Cynodonteae)—**2(2):**917
Brackish marshes—**1(1):**665
Bradburia pilosa—**1(1):**741
Brasiliopuntia—**1(1):**529
Brazil—**1(1):**529; **1(2):**913, 1023, 1119; **2(1):**45, 61, 75, 291, 305, 455, 551, 575; **2(2):**811, 843, 983
British Columbia, Canada—**2(1):**323
Bromeae (Poaceae: Pooideae)—**2(1):**323
Bromus—**2(1):**323
    sect. Bromeae—**2(1):**323
    sect. Bromopsis—**2(1):**323
    sect. Bromus—**2(1):**323
    sect. Genea—**2(1):**323
    kalmii var. occidentalis—**2(1):**323
    riparius—**2(1):**323
    squarrosus var. villosus—**2(1):**323
Brunelliaceae—**2(2):**1183
Bryanthus—**2(2):**1193
Bryson Field Press—**2(1):**517
Burma—**1(1):**91, 449; **2(2):**1175, 1183

C. Bickham-Dickson/Red River Education and Research Park, Louisiana, USA—**2(2):**1389
Cactaceae—**1(1):**529
Caesalpinioideae (Fabaceae)—**1(1):**121; **2(1):**463
Calamagrostis purpurascens subsp. **laricina**—**2(1):**434
Calamagrostis scopulorum Herbaceous Association—**1(1):**585
California, USA—**1(1):**47, 59, 69, 719; **2(1):**627, 743; **2(2):**775, 783
Calyptranthes **websteri**—**2(1):**297
Camellia
    japonica—**2(1):**637
    sasanqua—**2(1):**637
Campanulaceae—**1(2):**789; **2(1):**397
Campinas—**2(2):**983
Canada—**1(2):**1031; **2(1):**323, 433
Cannabaceae—**2(1):**627
Capanea—**2(1):**19
Capitan Mountains, New Mexico, USA—**2(1):**447
Capparaceae—**2(1):**61, 75; **2(2):**807
Capparidastrum—**2(1):**61
Capparis—**2(1):**61, 75
    leprieurii—**2(2):**807
Carchi Province, Ecuador—**2(1):**19
Carex—**1(1):**389
    arkansana—**2(1):**643
    billingsii—**1(1):**401
    breviculmis—**2(2):**1381
    hassei—**1(1):**69
    klamathensis—**1(1):**71
    meadii—**1(1):**69
    tetanica—**1(1):**69
    trisperma—**1(1):**389
        var. billingsii—**1(1):**389
        var. trisperma—**1(1):**389
Caribbean—**1(2):**899; **2(1):**35, 95, 139, 267, 463; **2(2):**799, 1165, 1167
Caryophyllaceae—**1(1):**763; **2(2):**1225, 1285
Cascabela—**2(1):**489
Cascade Mountains, USA—**1(1):**9; **2(2):**775
Cedar glade vegetation—**1(2):**1131
Celtis
    australis—**2(1):**627
    sinensis—**2(1):**627
Central America—**1(2):**827; **2(1):**41, 207; **2(2):**995, 1009, 1207
Centrosema—**1(2):**1101
Cerbera—**2(1):**489
Cereus—**1(1):**529
Cerrado—**2(2):**983
Chaetaria gibbosa—**2(1):**309
Chamaecrista adiantifolia var. pteridophylla—**2(1):**521
Chamaesyce ophthalmica—**2(1):**637
Chaubardia heteroclita—**1(2):**1003
Chenopodiaceae—**2(1):**425
Chenopodium subg. Ambrosia—**2(1):**425
Chihuahuan desert, Mexico—**1(1):**145
Chile—**2(2):**847
China—**1(1):**291; **2(1):**53
Chiricahua Mountains, Arizona, USA—**1(1):**47
Chloridoideae (Poaceae)—**1(2):**933; **2(2):**861, 875, 917
Chloris
    dubia—**2(2):**861
    truncata—**1(1):**719
Chondrosium
    drummondii—**2(2):**917
    foeneum—**2(2):**917
    subscorpioides—**2(2):**917
Chromosome number—**1(1):**431; **2(1):**487, 489
Chrysopsis
    elata—**1(1):**29
    nitidula—**1(1):**22
Chunky River, Mississippi, USA—**1(2):**1179
Chusquea—**1(2):**847
    albilanata—**1(2):**850
    annagardneriae—**1(2):**847
    sect. Verticillatae—**1(2):**847
Cirsium rydbergii Herbaceous Association—**1(1):**585
Cistaceae—**1(1):**367, 369
Clitoria—**1(2):**1101
    subg. Bractearia—**1(2):**1101
    subg. Neurocarpum—**1(2):**1101
Clitoriinae (Fabaceae: Phaseoleae)—**1(2):**1101
Clusiaceae—**1(1):**129, 713
Coahuila, Mexico—**1(2):**933; **2(2):**917, 1235
Coastal Prairie, USA—**1(1):**679; **1(2):**1141
Coleocephalocereus—**1(1):**529
Colicodendron—**2(1):**75
    bahianum—**2(1):**76
    scabridum—**2(1):**75

  - **valerabellum—2(1):**82
  - yco—**2(1):**75
- Colocasieae (Araceae)—**1(2):**815
- Colombia—**2(1):**25, 57, 61; **2(2):**861, 875, 1207, 1337
- Colorado Plateau, USA—**1(1):**585
- Colorado, USA—**2(1):**419; **2(2):**771, 1225, 1407
- Colurieae (Rosaceae)—**2(1):**415
- Comanche National Grasslands, USA—**2(2):**1407
- Comarum—**1(1):**31
- Combretaceae—**1(1):**486
- Conocarpus erectus—**1(1):**486
- Conservation Units—**1(1):**529
- Convolvulaceae—**2(2):**793
- Coptidium ×**spitsbergense—2(1):**437
- Cordia—**2(2):**837
- Cordiaceae—**2(2):**837
- Cornaceae—**1(1):**91
- Costa Rica—**2(1):**41; **2(2):**995
- Cotoneaster—**2(1):**53
  - ser. Dielsiani—**2(1):**53
  - dielsianus—**2(1):**53
  - **floridus—2(1):**55
  - ser. Franchetioides—**2(1):**53
  - **qungbixiensis—2(1):**53
  - ser. **Sterniani—2(1):**53
  - sternianus—**2(1):**53
- Cotyledon areoles—**1(2):**1101
- Crassulaceae—**1(2):**889, 1015
- Crataegus—**1(2):**1005, 1011, 1031; **2(1):**473
  - aboriginum—**1(2):**1011
  - apiomorpha—**1(2):**1011
    - var. cyanophylla—**1(2):**1011
  - ser. **Apricae—1(1):**173
  - **aquacervensis—1(2):**1061
  - blanchardii—**1(2):**1005
  - brazoria var. **viburnifolia—1(2):**1007
  - chrysocarpa
    - var. aboriginum—**1(2):**1012
    - var. **blanchardii—1(2):**1009
    - var. **praecox—1(2):**1009
    - var. **vigintistamina—1(2):**1008
  - coccinea var. **pringlei—1(2):**1005
  - **cupressocollina—1(2):**1056
  - ser. **Cupressocollinae—1(2):**1056
  - cyanophylla—**1(2):**1011
  - dissona—**1(2):**1005
  - divida—**1(2):**1011
  - ferrissii—**1(2):**1011
  - flava—**1(1):**171
  - ser. Flavae—**1(1):**171; **2(2):**1101
  - gattingeri—**1(2):**1008
  - gemmosa—**1(2):**1011
  - georgiana—**1(2):**1005
  - integriloba—**1(2):**1011
  - ser. Intricatae—**1(1):**171
  - jackii—**1(2):**1008
  - ser. Lacrimatae—**1(1):**171; **2(2):**1101
  - **lancei—2(2):**1101, **1143**
  - macracantha
    - var. divida—**1(2):**1012
    - var. integriloba—**1(2):**1012
    - var. pertomentosa—**1(2):**1012
  - mohrii—**1(2):**1005
  - **mollis** var. **incisifolia—1(2):1012**; **2(1):**473
  - ser. **Montaninsulae—1(2):**1065
  - neofluvialis—**1(2):**1005
  - pertomentosa—**1(2):**1011
  - pisifera—**1(2):**1011; **2(1):**473
  - praecox—**1(2):**1005
  - pruinosa
    - var. **dissona—1(2):**1007
    - var. rugosa—**1(2):**1012
    - var. virella—**1(2):**1013
  - **purpurella—1(2):**1066
  - reverchonii var. **mohrii—1(2):**1006
  - **rivuloadamensis—1(2):**1065
  - **rivulopugnensis—1(2):**1070
  - **rubribracteolata—1(2):**1073
  - rugosa—**1(2):**1011
  - schuettei
    - var. ferrissii—**1(2):**1013
    - var. **gigantea—1(2):1013**; **2(1):**473
  - sheila-phippsiae var. **saskatchewanensis—1(2):**1031, 1079
  - sheridana—**1(2):**1031
  - succulenta
    - var. gemmosa—**1(2):**1013
    - var. neofluvialis—**1(2):**1007
    - var. pisifera—**1(2):**1013
  - **ursopedensis—1(2):**1031, 1081
  - velutina—**1(2):**1005
  - viburnifolia—**1(2):**1005
  - viridis var. **velutina—1(2):**1009
- **Cretacifilix—2(2):**1176
  - **fungiformis—2(2):**1176
- Croton capitatus—**1(2):**1141
- Cryptogams—**2(2):**1309
- Cuatresia—**2(1):**41
  - **amistadensis—2(1):**41
- Cuba—**2(1):**267; **2(2):**799, 1165
- Cunoniaceae—**2(2):**1183
- Cyclopogon—**1(2):**1001
  - ovalifolium—**1(2):**1001
  - **secundum—1(2):**1001
- Cynodonteae (Poaceae: Chloridoideae)—**1(2):**933; **2(2):**917
- Cyperaceae—**1(1):**69, 389, 457, 779; **1(2):** 875, 1119; **2(1):**379; **2(2):**1381
- Cyperus—**2(1):**379
  - drummondii—**1(1):**779
  - grayi—**2(2):**1353
  - **karthikeyanii—2(1):**379
- Cypress Hills, Canada—**1(2):**1031

D
- Dahlia scapigera—**2(1):**605
- Daniel Boone National Forest, USA—**2(2):**1309
- Dasiphora—**1(1):**31
- Dátil Island, Mexico—**1(2):**1203
- Dead Horse Mountains, Texas, USA—**2(1):**685
- Dentella—**1(1):**373

- Diachea arboricola—**2(2):**1309
- Dicerandra
  - frutescens—**2(2):**1163
    - subsp. modesta—**2(2):**1163
  - **modesta**—**2(2):**1163
- Dichanthelium annulum—**2(2):**1353
- Diodia
  - gymnocephala—**2(1):**305
  - schumannii—**2(1):**305
- Diospyros
  - acapulcensis—**2(2):**1009
    - subsp. **chiquimulensis—2(2):**1025
    - subsp. **dwyeri—2(2):**1027
    - subsp. **guanacastensis—2(2):**1029
    - subsp. **mejocotensis—2(2):**1031
    - subsp. **nicaraguensis—2(2):**1033
    - subsp. **pedromorenoi—2(2):**1036
    - subsp. **rivensis—2(2):**1039
    - subsp. **veraecrucis—2(2):**1044
  - aequoris—**2(2):**1009
    - subsp. **balsensis—2(2):**1061
    - subsp. **chutlensis—2(2):**1065
    - subsp. **martineziana—2(2):**1069
    - subsp. **rekoi—2(2):**1071
    - subsp. **tehuantepecensis—2(2):**1074
  - amanap—**2(2):**1009
  - inconstans—**2(2):**1009
  - intricata—**2(2):**1009
  - salicifolia—**2(2):**1009
  - salicifolia complex—**2(2):**1009
  - yucatanensis—**2(2):**1009
    - subsp. **spectabilis—2(2):**1086
- District of Columbia, USA—**2(1):**627
- DNA content—**2(2):**1219
- DNA fingerprints—**1(1):**389
- Dominican Republic—**2(1):**35, 463; **2(2):**1167
- Doryopteris—**2(2):**843
  - cordifolia—**2(2):**843
  - sect. Doryopteris—**2(2):**843
  - **jequitinhonhensis—2(2):**843
  - trilobata—**2(2):**843
- Doubled rope climbing method (DRCM)—**2(2):**1309
- Dryas punctata subsp. **hookeriana—2(1):**441
- Drying press—**2(1):**517
- Drymocallis—**1(1):**31
  - **campanulata—1(1):**43
  - cuneifolia
    - var. cuneifolia—**1(1):**31
    - var. **ewanii—1(1):**44
  - **deseretica—1(1):**41
  - glandulosa
    - var. **reflexa—1(1):**43
    - var. **viscida—1(1):**43
    - var. **wrangelliana—1(1):**43
  - lactea var. **austiniae—1(1):**36
  - pseudorupestris
    - var. **crumiana—1(1):**39
    - var. **saxicola—1(1):**37
- Dudleya abramsii—**1(2):**1015
  - subsp. **costifolia—1(2):**1015
  - subsp. **setchellii—1(2):**1015
- Dysphania
  - **andicola—2(1):**428
  - **bonariensis—2(1):**428
  - **burkartii—2(1):**428
  - **congolana—2(1):**429
  - **dissecta—2(1):**429
  - **dunosa—2(1):**428
  - **mandonii—2(1):**429
  - **melanocarpa—2(1):**427
  - **microcarpa—2(1):**428
  - **minuata—2(1):**429
  - **nepalensis—2(1):**428
  - **oblanceolata—2(1):**428
  - **procera—2(1):**429
  - **pusilla—2(1):**427
  - **retusa—2(1):**428
  - **saxatilis—2(1):**427
  - **sooana—2(1):**428
  - **stellata—2(1):**429
  - **tomentosa—2(1):**428
  - **truncata—2(1):**427
  - **venturii—2(1):**428

- Early Cretaceous—**1(1):**91, 449; **2(2):**1175, 1183
- Ebenaceae—**2(2):**1009
- Echinodorus tenellus—**2(2):**1353
- Ecosystem transformers—**2(1):**743
- Ecuador—**1(2):**847, 853, 1001; **2(1):**19, 75, 297; **2(2):**1295, 1337
- Ehrharta erecta—**1(1):**719
- Eichhornia crassipes—**2(1):**637
- Eleocharis
  - acutangula—**1(2):**875
    - subsp. acutangula—**1(2):**875
    - subsp. **breviseta—1(2):**885
    - subsp. **neotropica—1(2):**886
  - engelmannii—**2(2):**1353
  - fistulosa var. robusta—**1(2):**875
  - kleinii—**1(2):**1119
  - liesneri—**1(2):**1119
- Elytrigia repens—**1(1):**719
- Endangered Species Act of 1973—**1(1):**457
- Endosperm—**1(2):**1101
- **Eoëpigynia—1(1):**92
  - **burmensis—1(1):**92
- Eperua falcata—**2(1):**521
- Epilobium brachycarpum—**1(1):**719
- Epiphyllum—**1(1):**529
- Episcia—**2(1):**275
  - **duidae—2(1):**275
  - fimbriata—**2(1):**275
  - reptans—**2(1):**275
  - **rubra—2(1):**277
  - sphalera—**2(1):**275
  - subsect. Trematanthera—**2(1):**275
- Episcieae (Gesneriaceae)—**2(2):**825
- Equisetum arvense subsp. **alpestre—2(1):**433
- Eragrostideae (Poaceae: Chloridoideae)—**2(2):**875

Eragrostis—**2(2):**875
  mokensis—**2(2):**875
  nigricans—**2(2):**875
  patula—**2(2):**875
  rufescens—**2(2):**875
  tenuifolia—**2(2):**875
  unioloides—**2(2):**875
Ericaceae—**1(1):**9, 97, 333; **1(2):**903; **2(1):**207, 243, 249; **2(2):**1193
Ericoideae (Ericaceae)—**2(2):**1193
Erigeron **heleniae**—**1(2):**891
Eriochloa aristata—**1(1):**719
Esmeraldas Province, Ecuador—**2(1):**19
Estuarine wetlands—**2(1):**743
Ethnobotany—**2(2):**1295
ETS—**2(1):**7
Eugenia—**1(2):**899
  concava—**2(1):**299
  grossa—**2(1):**299
Eupatorieae (Asteraceae)—**2(2):**811
Eupatorium serotinum—**1(2):**1141
Euphorbia peplus—**2(1):**649
Eupolypod fern—**2(2):**1175
Euro-Mediterranean—**1(1):**291
Euthamia—**1(1):**145
  graminifolia—**2(1):**7

Fabaceae—**1(1):**121; **1(2):**1101, 1253; **2(1):**387, 463; **2(2):**1491
Fabales—**2(1):**385
Fagaceae—**2(2):**1235
Festuca—**1(2):**827
  ×**gonzalez-ledesmae**—**1(2):**832
  subg. Helleria—**1(2):**827, 831
  livida—**1(2):**827
  longiligula—**1(2):**827
  ×**miscella**—**1(2):**835
  roemeri—**1(1):**59
    var. **klamathensis**—**1(1):**59
Field press—**2(1):**517
Fimbristylis—**2(1):**379
  naikii—**2(1):**381
  schoenoides—**2(2):**1353
Fisheating Bay, Florida, USA—**2(1):**633
Flora Caroliniana—**1(1):**407, 425; **1(2):**1091; **2(1):**475; **2(2):**1279
Flora de Goiás e Tocantins—**2(1):**455; **2(2):**983
Flora of Hispaniola—**2(2):**1165
Flora of North America north of Mexico—**1(1):**31; **1(2):**811, 889, 1005, 1011, 1015, 1017, 1019; **2(1):**201, 387, 395; **2(2):**783, 1285
Floret number—**1(1):**351
Florida, USA—**1(1):**741; **1(2):**1157; **2(1):**1, 633; **2(2):**1163, 1363
Flow diagrams—**1(2):**1131
Folia taxonomica—**1(1):**143; **1(2):**819, 895; **2(1):**263, 267, 269, 275, 281; **2(2):**817, 825, 837
Forsteronia—**1(1):**431
Fort Caroline National Memorial, USA—**1(2):**1157
Fossil—**1(1):**91; **2(1):**463; **2(2):**1183
Fossil flower—**2(2):**1167
Fossilized resin—**1(1):**449
Four Canyon Preserve, Oklahoma, USA—**1(1):**655
Fragaria—**1(1):**34
French Guiana—**1(1):**1; **1(2):**895; **2(2):**807
Fuirena pumila—**2(2):**1353
Fumaria—**2(2):**1347
  densiflora—**2(2):**1347
  officinalis—**2(2):**1347
  parviflora—**2(2):**1347
Furcraea bedinghausii—**2(1):**605

Galactomannan—**1(2):**1101
Galium
  anglicum—**1(2):**1269
  divaricatum—**1(2):**1269
  parisiense
    var. leiocarpum—**1(2):**1269
    var. parisiense—**1(2):**1269
Gamochaeta
  antillana—**1(2):**1125
  argyrinea—**1(2):**1125
  calviceps—**1(2):**1125
  chionesthes—**1(2):**1125
  coarctata—**1(2):**1125
  pensylvanica—**1(2):**1125
  purpurea—**1(2):**1125
Gardenieae (Rubiaceae)—**2(2):**983
Gaultheria
  miqueliana—**1(1):**97
  pyrolifolia—**1(1):**97
  pyroloides—**1(1):**97
Gaylussacia
  bigeloviana—**1(1):**336
  dumosa—**1(1):**333
  mosieri—**1(1):**333
  nana—**2(2):**1353
  orocola—**1(1):**333
Gender roles—**2(2):**1295
Generic realignment—**1(1):**31
Gentianopsis barbata subsp. **raupii**—**2(1):**442
Geocarpon minimum—**2(1):**643
Geographical Information System—**2(1):**677
Gesneriaceae—**2(1):**19, 269, 275; **2(2):**825
Geum—**2(1):**415
  donianum—**2(1):**417
Ghana—**1(1):**549
GIS—**2(1):**677
Glinus radiatus—**1(1):**719
Global change—**1(1):**486
Gloxinieae (Gesneriaceae)—**2(1):**19
Gnaphalieae (Asteraceae)—**2(1):**487
Goias, Brazil—**1(2):**1023; **2(1):**305; **2(2):**983
Gomesa—**1(2):**913
Gonolobinae (Apocynaceae: Asclepiadoideae)—**2(1):**95, 139
Gonolobus—**2(1):**95
  bayatensis—**2(1):**139
  broadwayae—**2(1):**139
  ciliatus—**2(1):**139

  - dictyopetalus—**2(1):**139
  - ekmanii—**2(1):**139
  - grenadensis—**2(1):**139
  - nipensis—**2(1):**139
  - sintenisii—**2(1):**139
  - stapelioides—**2(1):**95
  - tigrinus—**2(1):**139
  - tobagensis—**2(1):**139
  - variifolius—**2(1):**139
- Gratiola—**1(1):**149
  - ebracteata—**1(1):**149
  - flava—**1(1):**149, 763
  - floridana—**1(1):**149
  - **graniticola**—**1(1):**166
  - heterosepala—**1(1):**149
  - neglecta—**1(1):**149
  - sect. Nibora—**1(1):**149
  - **quartermaniae**—**1(1):**163
  - virginiana—**1(1):**149
- Great Smoky Mountains National Park, USA—**2(2):**1309
- Greater Antilles—**2(2):**1167
- Grindelia lanceolata—**2(1):**643
- Grossulariaceae—**1(2):**1015
- Guadalupe Mountains National Park, USA—**2(1):**677
- Guadua
  - **chaparensis**—**2(1):**31
  - **incana**—**2(1):**26
  - weberbaueri—**2(1):**25
- Guaduinae (Poaceae: Bambusoideae)—**2(1):**25
- Guerrero, Mexico—**1(1):**491
- Guiana Shield—**2(1):**263, 521; **2(2):**837
- Guianas—**1(2):**819, 1023; **2(1):**281
- Gulf Coast, North America—**1(1):**385
- Gulf Coastal Plain (Eastern), USA—**1(1):**577
- Gulf Coastal Plain (Western), USA—**1(1):**577; **1(2):**1149; **2(2):**1475
- Gulf of California, Mexico—**1(2):**1203
- Gundlachia—**1(1):**145
- Gutierrezia—**1(1):**145
  - **elegans**—**2(2):**771
- Guyana—**2(1):**281, 521
- Gymnosperma—**1(1):**145
- Gypsophily—**1(2):**891
- Gyptidinae (Asteraceae: Eupatorieae)—**2(2):**811

- **H**abitat model—**2(1):**677
- Haiti—**2(1):**267
- Hancock Biological Station, Kentucky, USA—**1(1):**609
- Hanging garden—**1(1):**585
- Hawaiian Island, USA—**1(2):**789
- Hawthorns—**1(2):**1031
- Hedyotideae (Rubiaceae)—**1(1):**373
- Hedyotis—**1(1):**109
  - **ekmanii**—**2(2):**1165
- Hedysarum boreale subsp. **dasycarpum**—**2(1):**441
- Heliotropiaceae—**2(1):**263
- Heliotropium—**2(1):**264
- Hesperostipa—**2(1):**165
- Heterotheca
  - **arizonica**—**1(1):**27
  - foliosa—**1(1):**21
  - fulcrata—**1(1):**21
    - var. amplifolia—**1(1):**21
    - var. arizonica—**1(1):**21
    - var. fulcrata—**1(1):**21
    - var. senilis—**1(1):**21
  - **nitidula**—**1(1):**24
  - viscida—**1(1):**21
  - zionensis—**1(1):**21
- Heuchera
  - sect. Holochloa subsect. Cylindricae—**2(1):**447
  - **woodsiaphila**—**2(1):**448
- Himalayacalamus
  - asper—**1(1):**135
  - **planatus**—**1(1):**137
- Hinton, James (memorium)—**1(2):**1277
- Hippopotamus—**1(1):**549
- Hispaniola—**2(2):**1165
- Hosackia—**2(1):**387
  - crassifolia var. **otayensis**—**2(1):**388
  - oblongifolia var. **cuprea**—**2(1):**388
  - stipularis var. **ottleyi**—**2(1):**388
- Houstonia—**1(1):**109
  - subg. Chamisme—**1(1):**109
  - subg. Ericotis—**1(1):**109
  - subg. **Porotis**—**1(1):**117
  - prostrata—**1(1):**109
  - purpurea—**1(1):**109
- Huachuca Mountains, Arizona, USA—**1(1):**47
- Hualapai Mountains, Arizona, USA—**1(1):**47
- Humboldtia—**1(1):**121
  - brunonis var. **raktapushpa**—**1(1):**121
- Hurricane Hugo—**1(1):**665
- Hydrilla verticillata—**2(1):**637
- Hydrocotyle bowlesioides—**1(1):**741
- Hydrophytes—**1(1):**719
- Hylocereus—**1(1):**529
- Hypericum
  - adpressum—**1(1):**713
  - lloydii—**2(2):**1353

- **I**batia mollis—**2(1):**139
- Iceland—**2(1):**433
- Illiciaceae—**2(2):**799
- Illicium
  - cubense subsp. guajaibonense—**2(2):**799
  - **guajaibonense**—**2(2):**800
- India—**1(1):**121, 129; **1(2):**903; **2(1):**373, 379
- Interior Highlands, USA—**2(2):**761
- Intersimple sequence repeats (ISSR)—**1(1):**85
- Invasive plants—**2(1):**743
- Ipomoea
  - concolora—**2(2):**793
  - conzattii—**2(2):**793
  - subg. Eriospermum—**2(2):**793
  - ser. Mirandinae—**2(2):**793
  - **tehuantepecensis**—**2(2):**793
- Islas Tiburón, Mexico—**1(2):**1203
- ITS—**2(1):**7
- Ixora—**2(1):**455

    araguaiensis—2(1):456
    congestiflora—2(1):456
    irwinii—2(1):459
Ixoroideae (Rubiaceae)—**2(1):**455

Jacaima
    costata var. goodfriendii—**2(1):**139
    parvifolia—**2(1):**139
Jalisco, Mexico—**1(1):**499; **2(2):**1009, 1341
Jarava—**2(1):**165
    Jarava subg. Pappostipa—**2(1):**165
Jepson Manual, The—**1(2):**1017; **2(1):**387, 397, 783
Juncaceae—**2(2):**775
Juncus
    articulatus—**2(2):**1353
    sect. Caespitosi—**2(2):**775
    digitatus—2(2):775
    dudleyi—**2(2):**1353
    interior—**2(2):**1353
    militaris—**2(2):**1353
    nodatus—**2(2):**1353
    subcaudatus—**2(2):**1353
    triformis—**2(2):**775

Kaieteur National Park, Guyana—**2(1):**521
Kalmia angustifolia—**2(2):**1353
Kalmiopsis
    fragrans—1(1):10
    leachiana—**1(1):**9
Kansas, USA—**1(1):**753
Karnataka, India—**2(1):**379
Kentucky Lake, USA—**1(1):**609
Kentucky, USA—**1(1):**609; **2(2):**1309
Kiowa National Grasslands, USA—**2(2):**1407
Klamath (Siskiyou) Mountains, USA—**1(1):**9
Klamath Region, USA—**1(1):**59, 69
Koeleria pyramidata subsp. **seminuda—2(1):**434
Kohautia—**1(1):**373
Kohleria—**2(1):**19
    hypertrichosa—2(1):20
Kruschke, Emil P.—**1(2):**1011; **2(1):**473
Kwakwani, Guyana—**2(1):**521

Lachnociona terriae—**2(2):**1183
Lachnociona—2(2):1184
    terriae—2(2):1184
Lake Okeechobee, Florida, USA—**2(1):**633
Lake Wales Ridge, Florida, USA—**2(2):**1163
Lamiaceae—**1(1):**717; **2(1):**193; **2(2):**761, 1163
Lasiambix—2(1):464
    dominicensis—2(1):464
Lasiolaena—**2(2):**811
    lychnophorioides—2(2):812
Laubertia—**1(1):**431
    contorta—**1(1):**431
Leaf blade anatomy—**2(1):**495
Lechea
    maritima—**1(1):**367
        var. virginica—**1(1):**367
    pulchella var. **ramosissima—1(1):**370
    san-sabeana—**2(1):**643
Ledothamnus—**2(2):**1193
Lepismium—**1(1):**529
Leptochloa—**2(2):**861
Leucospora multifida—**2(2):**1353
Liabeae (Asteraceae)—**2(2):**1207
Liabum meridense—**2(2):**1207
Lilaeopsis carolinensis—**2(2):**1497
Limnanthaceae—**1(2):**1017
Limnanthes—**1(2):**1017
    alba
        subsp. **gracilis—1(2):**1017
        subsp. **parishii—1(2):**1017
    douglasii subsp. **striata—1(2):**1017
Limnorchis
    aquilonis—2(1):434
    huronensis—2(1):434
Limonium
    indet.—**1(1):**719
    ramosissimum—**1(1):**719
Lipocarpha drummondii—**2(2):**1353
Lobelia—**1(2):**789
    sect. Galeatella—**1(2):**789, 798
    gaudichaudii—**1(2):**800, 804
    gloria-montis—**1(2):**800, 804
        subsp. gloria-montis—**1(2):**800, 805
        subsp. **longibracteata—1(2):**806
    ×**kauaiensis—1(2):**801
    koolauensis—1(2):803
    villosa—**1(2):**800
    wahiawa—1(2):802
Lobelioideae (Campanulaceae)—**1(2):**789
Lone Mesa State Park, Colorado, USA—**2(2):**771
Loropetalum chinense—**2(1):**637
Loteae (Fabaceae)—**2(1):**387
Louisiana, USA—**1(1):**717, 763; **1(2):**1125, 1141, 1251; **2(1):**643; **2(2):**1389
Lucya—**1(1):**118
    tetrandra—**1(1):**109
Luziola subintegra—**2(1):**633
Lycurus—**1(2):**933, 941
Lyonothamneae (Rosaceae)—**2(1):**385
Lyonothamnus—**2(1):**385

Macleania
    coccinea—**2(1):**243
    insignis—**2(1):**243
Madagascar—**2(2):**843
Madrean Archipelago (sky islands), North America—**1(1):**47
Magdalena River, Colombia—**2(1):**605
Magrath, Lawrence K. (memorium)—**1(1):**781
Maharashtra, India—**2(1):**379
Malvaceae—**2(2):**783
Mancos Shale—**2(2):**771
Mandevilla—**1(2):**853, 859
    aequatorialis—1(2):853
    frigida—1(2):855
    hirsuta—**1(2):**859
    horrida—1(2):863
    inexperata—1(2):865
    lojana—1(2):855

    megabracteata—**1(2):**866
    similaris—**1(2):**867
Mangrove—**1(1):**486
Mapping—**2(2):**1363
Marsilea quadrifolia—**2(1):**637
Matelea—**2(1):**139
    costata var. **goodfriendii**—**2(1):**150
    dictyopetala—**2(1):**130
    proctori—**2(1):**151
    pubescens—**2(1):**131
Maxillaria heteroclita—**1(2):**1003
Medranoa—**1(1):**145
    johnstonii—**1(1):**148
    palmeri—**1(1):**148
    pseudobaccharis—**1(1):**148
    purpusii—**1(1):**148
Melastomataceae—**2(1):**35
Meliosma **antioquiensis**—**2(1):**57
Mesechiteae (Apocynaceae: Apocynoideae)—**1(2):**853, 859
Mesoamerica—**2(2):**1009
Mexico—**1(1):**47, 79, 109, 145, 431, 486, 491, 499, 511, 779; **1(2):**827, 871, 891, 933, 1203; **2(1):**207, 495, 547, 593, 605; **2(2):**793, 917, 1009, 1235, 1341
Mexico City, Mexico—**2(1):**605
Mexico, Valley of—**2(1):**605
Michoacan, Mexico—**2(1):**547
Miconieae (Melastomataceae)—**2(1):**35
Micranthes—**1(2):**1019
    bryophora—**1(2):**1020
    calycina—**1(2):**1020
    ferruginea—**1(2):**1020
    foliolosa—**1(2):**1020
    gormanii—**1(2):**1020
    hieraciifolia subsp. **longifolia**—**2(1):**439
    idahoensis—**1(2):**1020
    lyallii subsp. **hultenii**—**2(1):**440
    merkii—**2(1):**440
    mexicana—**1(2):**1020
    nelsoniana
        subsp. **aestivalis**—**2(1):**440
        var. **aestivalis**—**1(2):**1020
        var. **carlottae**—**1(2):**1020
        var. **cascadensis**—**1(2):**1020
        subsp. **insularis**—**2(1):**440
        var. **insularis**—**1(2):**1020
        var. **pacifica**—**1(2):**1020
        var. **porsildiana**—**2(1):**395
    nudicaulis—**1(2):**1021
    petiolaris—**1(2):**1021
    porsildiana—**2(1):**440
    razshivinii—**1(2):**1021
    redofskyi—**2(1):**441
    tempestiva—**1(2):**1021
    tischii—**1(2):**1021
    tolmiei—**1(2):**1022
    unalaschcensis—**1(2):**1022
Mimosoideae (Fabaceae)—**2(2):**1491
Minas Gerais, Brazil—**2(2):**843
Minuartia
    austromontana—**2(2):**1225
    drummondii—**1(1):**763
    filiorum—**2(2):**1225
    macrantha—**2(2):**1225
    muriculata—**1(1):**763
    muscorum—**1(1):**763
    rossii-stricta—**2(2):**1225
    rubella—**2(2):**1225
    stricta—**2(2):**1225
Mirablis hintoniorum—**2(1):**547
Mississippi Natural Heritage Program, USA—**1(2):**1179
Mississippi, USA—**1(1):**769; **1(2):**1179; **2(2):**1381
Mississippi, Yazoo-Mississippi Delta Region, USA—**1(1):**769
Missouri, USA—**2(2):**1309
Mizoram, India—**1(2):**903
Modeling—**2(2):**1363
Mogolon Rim, Arizona, USA—**1(1):**47
Monarda lindheimeri—**1(1):**717
Monilicarpa—**2(1):**67
    brasiliana—**2(1):**71
    tenuisiliqua—**2(1):**70
Monopyle—**2(1):**19
Moraceae—**2(2):**1167
Morisita community similarity index—**1(1):**585
Morphometrics—**1(1):**389
Morro Alto Mourão, Brazil—**2(1):**575
Mosiera—**1(2):**899
    androsiana—**1(2):**899
    cuspidata—**1(2):**899
    gracilipes—**1(2):**899
    xerophytica—**1(2):**900
Mudflats—**2(1):**743
Muhlenbergia—**1(2):**933
    capillaris—**1(1):**85
    expansa—**1(1):**85
    glomerata var. ramosa—**1(2):**933
    sericea—**1(1):**85
    spiciformis—**1(2):**933
Muhlenbergiinae (Poaceae: Chloridoideae: Cynodonteae)—**1(1):**85; **1(2):**933
Munrochloa—**2(1):**374
    ritchiei—**2(1):**376
Murray State University—**1(1):**609
Myanmar—**1(1):**91, 449; **2(2):**1175, 1183
Myrcia **subcordifolia**—**2(1):**303
Myriophyllum spicatum—**2(1):**637
Myriopus—**2(1):**263
    candidulus—**2(1):**264
    maculatus—**2(1):**264
    paniculatus—**2(1):**264
        var. **spigeliiflorus**—**2(1):**264
    volubilis—**2(1):**264
Myrtaceae—**1(2):**899; **2(1):**297
Myxomycetes—**2(2):**1309

Nagaland, India—**1(2):**903
Nash Prairie, Texas, USA—**1(1):**679
Nassella-Amelichloa clade—**2(1):**165

- National List of Plants that Occur in Wetlands, USA—**1(1):**719
- National Park Service, USA—**1(2):**1157
- Natural Municipal Park of Prainha, Brazil—**1(1):**529
- Nature Conservancy, The—**1(1):**655, 777
- Nautilocalyx
  - **crenatus—2(2):**825
  - **orinocensis—2(2):**833
  - **paujiensis—2(2):**827
  - **pusillus—2(2):**827
  - **roseus—2(2):**830
  - **ruber—2(2):**830
  - **vestitus—2(2):**833
- Neanotis—**1(1):**373
- Nemacladus—**2(1):**397
  - **australis—2(1):**398
  - **calcaratus—2(1):**399
  - **californicus—2(1):**397
  - glanduliferus
    - var. australis—**2(1):**397
    - var. orientalis—**2(1):**397
  - **orientalis—2(1):**398
  - rubescens var. tenuis—**2(1):**397
  - secundiflorus var. **robbinsii—2(1):**399
  - **tenuis—2(1):**398
    - var. **aliformis—2(1):**398
- Neocalyptrocalyx **morii—2(2):**807
- Neonesomia—**1(1):**145
- Neotropics—**1(2):**853, 859, 1023; **2(1):**285, 305; **2(2):**1207
- Nepal—**1(1):**135
- Neptunia plena—**2(2):**1491
- Nevada, USA—**1(1):**351
- *New Manual of Botany of the Central Rocky Mountains*—**2(1):**201
- New Mexico, USA—**1(1):**351; **2(1):**419, 447; **2(2):**1407
- Nicoraepoa—**2(2):**847
- *Norma Oficial Mexicana*—**1(1):**491; **2(1):**605
- North America—**1(1):**31, 59, 109, 149, 291, 333, 357, 385; **1(2):**871, 1005, 1011, 1019, 1031, 1149; **2(1):**201, 323, 387, 397, 401, 415, 425, 473, 487, 621, 627; **2(2):**775, 783, 793, 917, 1009, 1235, 1285, 1341, 1347, 1353, 1363, 1381, 1407
- North Carolina, USA—**1(1):**345; **2(1):**649; **2(2):**1309
- Norway—**2(1):**433
- Nuclear magnetic resonance spectroscopy—**1(1):**449
- Nuevo Leon, Mexico—**1(2):**891, 933; **2(1):**593; **2(2):**917
- Nuphar—**2(1):**593
  - advena—**2(1):**593
- Nyctaginaceae—**1(2):**871; **2(1):**419, 547
- Nymphaea—**2(1):**593
  - ampla—**2(1):**593
  - elegans—**2(1):**593
  - mexicana—**2(1):**593
- Nymphaeaceae—**2(1):**593

- **O**ak-hickory forest—**1(1):**609
- Oaxaca, Mexico—**2(2):**793, 1009
- Oenothera arizonica—**1(1):**483
- Oklahoma Natural Heritage Inventory—**1(1):**655
- Oklahoma, USA—**1(1):**655, 777; **1(2):**1125; **2(2):**761
- Oldenlandia—**1(1):**373
  - strigulosa—**1(1):**373
- Oldenlandiopsis—**1(1):**373
- Oligactis—**2(2):**1207
  - subg. Andromachiopsis—**2(2):**1207
  - biattenuata—**2(2):**1207
  - boyacensis—**2(2):**1207
  - garcia-barrigae—**2(2):**1207
  - subg. Oligactis—**2(2):**1207
  - sessiliflora—**2(2):**1207
  - valeri—**2(2):**1207
  - volubilis—**2(2):**1207
- Olyreae (Poaceae: Bambusoideae)—**1(1):**1
- Onagraceae—**1(1):**483
- Oncidiinae (Orchidaceae)—**1(2):**913
- Oncosiphon piluliferum—**1(1):**719
- Open woods—**2(1):**661
- Opuntia—**1(1):**529
- Orchidaceae—**1(2):** 913, 1001, 1003, 1265; **2(1):**285
- Orchidotypus—**2(1):**285
- Oregon, USA—**1(1):**9, 59, 69
- Orthaea **laurifolia—2(1):**244
- Oryzeae (Poaceae)—**2(1):**633, 673
- Ottelia alismoides—**1(1):**741
- Ottleya—**2(1):**387
- Ouachita Mountains, Arkansas, USA—**1(1):**713
- Oxalidales—**2(2):**1183
- Oxbow lake—**2(2):**1389
- Oxytenanthera—**2(1):**373

- **P**achyphyllum—**2(1):**285
  - sect. **Capitulum—2(1):**288
  - sect. **Orchidotypum—2(1):**287
- Packera hyperborealis subsp. **wrangelica—2(1):**443
- Pakaraima Mountains, Guyana—**2(1):**521
- Pakistan—**1(1):**557, 569
- Pan de Guajaibón, Cuba—**2(2):**799
- Panamá—**2(1):**41, 521; **2(2):**1009
- Panarctic Flora Checklist—**2(1):**433
- Panarctic Vascular Plant Flora—**2(1):**433
- Panay Island, Philippines—**1(2):**815
- Paniceae (Cyperaceae)—**1(1):**69
- Panicum
  - coloratum—**1(1):**719
  - dichotomiflorum
    - subsp. dichotomiflorum—**1(1):**719
    - var. puritanorum—**2(2):**1353
  - diffusum—**2(1):**643
  - virgatum—**1(1):**719
- Papaver **labradoricum—2(1):**438
- Papaveraceae—**2(2):**1347
- **Pappostipa—2(1):**181
  - **ameghinoi—2(1):**184
    - var. **digona—2(1):**184
    - var. **precordillerana—2(1):**184
  - **atacamensis—2(1):**184
  - **barrancaensis—2(2):**1233
  - **braun-blanquetii—2(1):**183
  - **chrysophylla—2(1):**185
    - var. **cordillerarum—2(1):**185

    - var. **crispula**—**2(1):**185
    - f. **minuta**—**2(1):**185
    - f. **modica**—**2(1):**185
  - sect. **Chrysovaginatae**—**2(1):**184
  - **chubutensis**—**2(1):**185
    - var. **hirsutissima**—**2(1):**185
  - **frigida**—**2(1):**185
    - var. **parvispicula**—**2(1):**185
  - **hieronymusii**—**2(1):**183
  - **humilis**—**2(1):**185
    - var. **decrescens**—**2(1):**185
    - var. **ruiziana**—**2(1):**185
  - **ibarii**—**2(1):**184
    - f. **pallescens**—**2(1):**184
    - var. **anomala**—**2(1):**184
  - **maeviae**—**2(1):**183
  - **major**—**2(1):**184
  - **malalhuensis**—**2(1):**183
  - **nana**—**2(1):**184
  - **nicorae**—**2(1):**183
  - sect. **Pappostipa**—**2(1):**182
  - **parodiana**—**2(1):**183
  - **patagonica**—**2(1):**183
  - **ruiz-lealii**—**2(1):**183
  - **semperiana**—**2(1):**183
  - **sorianoi**—**2(1):**184
  - **speciosa**—**2(1):**182
    - f. **abscondita**—**2(1):**182
    - var. **atuelensis**—**2(1):**182
    - var. **breviglumis**—**2(1):**182
    - var. **ciliata**—**2(1):**182
    - f. **horrida**—**2(1):**182
    - var. **manqueclensis**—**2(1):**182
    - var. **media**—**2(1):**182
    - var. **parva**—**2(1):**182
  - **vaginata**—**2(1):**182
    - var. **argyroidea**—**2(1):**183
    - f. **contracta**—**2(1):**183
    - var. **dilatata**—**2(1):**183
    - f. **inmersa**—**2(1):**183
    - f. **laevis**—**2(1):**183
    - f. **rigida**—**2(1):**183
  - **vatroensis**—**2(1):**184
- Paraguay—**2(1):**61
- Parishella californica—**2(1):**397
- Parque Internacional la Amistad, Central America—**2(1):**41
- Paspalum—**2(1):**743
  - urvillei—**1(1):**719; **1(2):**1141
  - vaginatum—**2(1):**743
- Passiflora
  - **angusta**—**2(2):**818
  - **arta**—**1(2):**819
  - supersect. Auriculata—**2(2):**817
  - coccinea—**1(2):**819; **2(1):**281
  - supersect. Coccinea—**1(2):**824; **2(1):**281
  - **compar**—**1(2):**821
  - cryptopetala—**2(2):**817
  - **davidii**—**1(2):**896
  - subg. Decaloba—**2(2):**817
  - foetida—**1(1):**143
    - var. **orinocensis**—**1(1):**144
  - heterophylla—**2(1):**267
  - **insueta**—**2(1):**267
  - miniata—**2(1):**281
  - subg. Passiflora—**1(2):**819, 895
  - **rufa**—**2(2):**822
  - supersect. Stipulata—**1(2):**895
    - sect. Calopathanthus—**1(2):**895
    - sect. Dysosmia—**1(2):**895
    - sect. Granadillastrum—**1(2):**895
    - sect. Kermesinae—**1(2):**895
    - sect. Tacsonioides—**1(2):**895
  - **tecta**—**2(1):**281
  - sect. **Trematanthera**—**2(1):**277
- Passifloraceae—**1(1):**143; **1(2):**819, 895; **2(1):**267; **2(2):**817
- Pawnee National Grasslands, USA—**2(2):**1407
- Pennisetum setaceum—**2(1):**637
- Pennsylvania, USA—**1(1):**631; **2(2):**1449
- Pentodon—**1(1):**373
- Pereskia—**1(1):**529
- Periandra—**1(2):**1101
- Pertle Springs, Missouri, USA—**2(2):**1309
- Peru—**1(2):**841, 853; **2(1):** 75, 249
- Petradoria
  - pumila—**1(1):**351
    - var. graminea—**1(1):**351
    - var. pumila—**1(1):**351
- Phaseoleae (Fabaceae)—**1(2):**1101
- Phellodendron—**1(1):**357
  - amurense—**1(1):**357
  - chinense—**1(1):**357
- Philadelphaceae—**1(2):**901
- Philadelphus—**1(2):**901
  - microphyllus
    - var. **argyrocalyx**—**1(2):**901
    - var. **madrensis**—**1(2):**901
    - var. **stramineus**—**1(2):**901
- Philippines—**1(2):**815
- Phragmites
  - australis—**1(1):**385
    - subsp. americanus—**1(1):**385
    - subsp. **berlandieri**—**1(1):**387
- Phylogenetic analysis—**2(1):**401
- Phylogenetic relationships—**2(2):**1193
- Phylogeny—**1(2):**913; **2(1):**7
- Phytogeographical analysis—**2(2):**1475
- Phytogeography—**1(1):**389; **1(2):**1149
- Pilea—**2(2):**995
  - **alfaroana**—**2(2):**995
  - **gamboana**—**2(2):**997
  - **herrerae**—**2(2):**1000
  - **longibracteolata**—**2(2):**1002
  - **moragana**—**2(2):**1004
- Pilosocereus—**1(1):**529
- Pinar del Rio, Cuba—**2(2):**799
- Piptochaetium—**2(1):**165
- Plant biodiversity—**1(1):**549
- Plant communities—**1(1):**557

- Plant press—**2(1):**517
- Plant succession—**1(2):**1131
- Plantaginaceae—**1(1):**149, 763
- Plumerieae (Apocynaceae: Rauvolfoidae)—**2(1):**489
- Poa—**2(2):**847
  - hachadoensis var. pilosa—**2(2):**847
  - mendocina—**2(2):**847
  - patula—**2(2):**875
  - **pfisteri**—**2(2):**850
  - unioloides—**2(2):**875
- Poaceae—**1(1):**1, 59, 85, 135, 385; **1(2):**827, 841, 847, 933; **2(1):**25, 165, 309, 323, 373, 495, 633, 673, 743; **2(2):**847, 861, 875, 917, 1233
- Poeae (Poaceae)—**1(2):**827
- Poeciloneuron
  - indicum—**1(1):**129
  - pauciflorum—**1(1):**129
- Poicilla
  - costata—**2(1):**139
  - tamnifolia—**2(1):**139
- Poicillopsis crispiflora—**2(1):**139
- Poidium juergensii—**2(2):**875
- Poinae (Poaceae)—**1(2):**841
- Pollination—**2(2):**1163
- Polygala leptostachys—**2(2):**1353
- Polygonum glaucum—**2(2):**1353
- Polypodiales—**2(2):**1175
- Pooideae (Poaceae)—**2(1):**323
- Portulacaceae—**1(1):**777
- Potaro River, Guyana—**2(1):**521
- Potentilla—**1(1):**31; **1(2):**811; **2(1):**201
  - albiflora—**1(1):**47
  - anserina subsp. **yukonensis**—**2(1):**441
  - arenosa subsp. **chamissonis**—**1(2):**813
  - sect. Aureae—**1(1):**47
  - concinna var. divisa—**2(1):**201
  - sect. Concinnae—**2(1):**201
  - cottamii—**1(1):**47
  - **demotica**—**1(1):**53
  - sect. Hippianae—**2(1):**201
  - **holmgrenii**—**1(2):**811
  - hyparctica subsp. **elatior**—**1(2):**813
  - **jepsonii**—**2(1):**202
  - sect. Leucophylleae—**2(1):**201
  - litoralis—**2(1):**201
  - luteosericea—**1(1):**47
  - sect. Multifidae—**2(1):**201
  - nivea—**1(2):**811
    - var. dissecta—**2(1):**201
  - sect. Niveae—**1(2):**811; **2(1):**201
  - pensylvanica—**2(1):**201
    - var. ovium—**2(1):**201
  - pinetorum—**1(1):**47
  - pseudosericea—**2(1):**201
  - ramulosa—**1(1):**47
  - **rhyolitica**—**1(1):**50
    - var. **chiricahuensis**—**1(1):**52
  - sect. Rubricaules—**2(1):**201
  - sect. Subjugae—**2(1):**201
  - subviscosa—**1(1):**47
  - sect. Subviscosae—**1(1):**47
  - sect. Supinae—**2(1):**201
  - wheeleri var. viscidula—**1(1):**47
- Potentilleae (Rosaceae: Rosoideae)—**1(1):**31
- Pothowar Plateau, Pakistan—**1(1):**557
- Prairies—**2(2):**1475
- Praxelis clematidea—**2(1):**621
- Prestonia—**1(1):**431
- Prunus
  - alleghaniensis—**2(1):**401
  - americana—**2(1):**401
  - angustifolia—**2(1):**401
  - gracilis—**2(1):**401
  - hortulana—**2(1):**401
  - maritima—**2(1):**401
  - mexicana—**2(1):**401
  - munsoniana—**2(1):**401
  - murrayana—**2(1):**401
  - sect. Prunocerasus—**2(1):**401
  - rivularis—**2(1):**401
  - subcordata—**2(1):**401
  - texana—**2(1):**401
  - umbellata—**2(1):**401
- Pseudoxytenanthera—**2(1):**373
  - ritchiei—**2(1):**373
- Psidium—**1(2):**899
  - calciolum—**2(2):**1165
- Psilocarphus chilensis—**1(1):**719
- Pteridaceae—**2(2):**843
- Ptilagrostis—**2(1):**165
- Puccinellia phryganodes
  - subsp. **neoarctica**—**2(1):**435
  - subsp. **sibirica**—**2(1):**435
- Pycnanthemum—**2(1):**193
  - sect. Aristatae—**2(1):**193
  - sect. Brachystemum—**2(1):**193
  - sect. **Californicae**—**2(1):**195
  - sect. Capitellatae—**2(1):**193
  - flexuosum—**2(2):**1353
  - sect. Macrocephalae—**2(1):**193
  - sect. Nudae—**2(1):**193
  - sect. Pycnanthemum—**2(1):**193
  - virginianum—**2(1):**193

- **Q**uarterman, Elsie—**1(2):**1131
- Quercus—**2(2):**1235
  - acutissima—**2(1):**637
- Quillaja—**2(1):**385
- Quillajaceae—**2(1):**385

- **R**addiella
  - esenbeckii—**1(1):**1
  - minima—**1(1):**1
  - **vanessiae**—**1(1):**1
- Ranunculaceae—**2(1):**741
- Ranunculus
  - ficaria—**2(1):**741
    - subsp. bulbifera—**2(1):**741
  - laxicaulis—**1(1):**741

  - subborealis
    - subsp. **pumilus—2(1):**437
    - subsp. **villosus—2(1):**438
- Raphiolepis indica—**2(1):**637
- Rauvolfoidae (Apocynaceae)—**2(1):**489
- Regional floristic relationships—**2(1):**685
- Rhipsalis—**1(1):**529
- Rhododendron tomentosum subsp. **decumbens—2(1):**441
- Rhynchospora cephalantha var. attenuata—**2(2):**1353
- Ribes oxyacanthoides var. **cognatum—1(2):**1015
- Rincon Mountains, Arizona, USA—**1(1):**47
- Rio de Janeiro, Brazil—**1(1):**529; **2(1):**575
- Rio Grande do Sul, Brazil—**1(2):**1119
- Riparian—**1(1):**719
- Riparian forests—**2(1):**521
- Rocky Mountains, USA—**2(2):**1225
- Roraima sandstone—**2(1):**521
- Rosaceae—**1(1):**31, 47, 171; **1(2):**811, 1005, 1011, 1031; **2(1):**53, 201, 385, 401, 415, 473; **2(2):**1101
  - tribus **Lyonothamneae—2(1):**385
  - subseries **Robustae—2(2):**1124
  - subseries **Tenues—2(2):**1108
- Rosales—**2(1):**385
- Rosid—**2(2):**1183
- Rosoideae (Rosaceae)—**1(1):**31
- Rubiaceae—**1(1):**109, 373; **1(2):**1023, 1269; **2(1):**305, 455; **2(2):**983
- Russia—**2(1):**433
- Rutaceae—**1(1):**357

- **S**abiaceae—**2(1):**57
- Sagittaria
  - chapmani—**2(2):**1353
  - graminea—**1(1):**345
  - macrocarpa—**1(1):**345
  - subulata—**2(1):**643
- Saline prairie—**1(2):**1251
- Salt marsh—**2(1):**743
- Salvia toaensis—**2(2):**1165
- Salvia **toaensis—2(2):**1165
- Salvinia molesta—**1(1):**719
- San Esteban Island, Mexico—**1(2):**1203
- San Jacinto River, Texas, USA—**2(1):**661
- San Marcos River, Texas, USA—**2(1):**673
- San Pedro Nolasco Island, Mexico—**1(2):**1203
- Santa Catalina Mountains, Arizona, USA—**1(1):**47
- Santa Catarina, Brazil—**1(2):**1119
- Santa Rita Mountains, Arizona, USA—**1(1):**47
- Saskatchewan, Canada—**1(2):**1031
- Satureja virginiana—**2(1):**193
- Saxifraga texana—**1(2):**1251
- Saxifragaceae—**1(2):**1019, 1251; **2(1):**395, 447
- Saxifragales—**2(2):**1183
- Schoenoplectus hallii—**1(1):**457
- Sclerolepis uniflora—**2(2):**1353
- Scorzoneroides autumnalis subsp. **pratensis—2(1):**443
- Seashore—**2(1):**743
- Seasonally Dry Tropical Forest—**2(1):**551
- Sedge—**1(1):**389
- Sedge ecology—**1(1):**389
- Sedum—**1(2):**889
  - lanceolatum var. **subalpinum—1(2):**890
  - laxum
    - var. **eastwoodiae—1(2):**889
    - var. **flavidum—1(2):**889
    - var. **heckneri—1(2):**889
    - var. **latifolium—1(2):**890
  - obtusatum
    - var. **boreale—1(2):**889
    - var. **paradisum—1(2):**889
    - var. **retusum—1(2):**889
  - oreganum var. **tenue—1(2):**890
  - radiatum
    - var. **ciliosum—1(2):**889
    - var. **depauperatum—1(2):**889
  - stenopetalum var. **monanthum—1(2):**890
  - wrightii
    - var. **densiflorum—1(2):**889
    - var. **priscum—1(2):**889
- Seed bank—**1(1):**569
- Seed dispersal—**1(1):**569
- Seed germination—**2(1):**673
- Senecio
  - ampullaceus—**2(1):**643
  - cymbalarioides—**2(2):**1215
  - subnudus—**2(2):**1215
  - subpeltatus—**2(2):**1215
- Senecioneae (Asteraceae)—**2(2):**1215
- Seriphidium quettense—**1(1):**569
- Serpentine endemic—**1(1):**69
- Serra da Tiririca Mountains, Brazil—**2(1):**575
- Serra da Tiririca State Park, Brazil—**2(1):**575
- Serra do Orobó Mountains, Brazil—**2(1):**551
- Setaria
  - adharerens—**1(1):**719
  - megaphylla—**1(1):**719
- Sibbaldia—**1(1):**31
- Sibbaldiopsis—**1(1):**31
- Sidalcea—**2(2):**783
  - hickmanii
    - subsp. **napensis—2(2):**783
    - subsp. **pillsburiensis—2(2):**786
- Sierra de Baoruco, Dominican Republic—**2(1):**35
- Sierra de Coalcomán, Michoacán, México—**2(1):**547
- Sierra Kunkaak, Mexico—**1(2):**1203
- Sierra Madre del Sur, Mexico—**1(1):**491
- Sierra Martin Garcia, Dominican Republic—**2(1):**35
- Silene
  - flos-cuculi subsp. flos-cuculi—**2(1):**649
  - involucrata subsp. **furcata—2(1):**436
  - soczavana var. **macrosperma—2(1):**436
  - **villosula—2(1):**437
  - **violascens—2(1):**437
- Sinaloa, Mexico—**1(1):**109; **2(2):**1009
- Sino-Himalaya—**1(1):**135
- Siphonandra—**2(1):**249
  - boliviana—**2(1):**249
  - elliptica—**2(1):**249

  - magnifica—**2(1):**249
  - **nervosa**—2(1):256
  - **santa-barbarense—2(1):**256
- Soil types—**1(1):**557
- Solanaceae—**2(1):**41
- Solidago
  - altissima—**1(2):**1141
  - canadensis—**2(1):**7
  - gigantea—**1(1):**741
  - multiradiata subsp. **arctica—2(1):**443
  - ptarmicoides—**2(1):**7
- Solidaster (Solidago × Aster)—**2(1):**7
- Sonora, Mexico—**1(1):**109
- Sonoran Desert, Central Gulf Coast subdivision—**1(2):**1203
- Sonoran Desert, Mexico—**1(1):**145
- Sonoran Islands, Mexico—**1(2):**1203
- Sørenson index—**2(2):**1407
- South Africa—**2(2):**1215
- South America—**1(1):**1, 143; **1(2):**819, 841, 847, 853, 895, 913, 1001, 1023, 1119; **2(1):**19, 25, 45, 57, 61, 75, 249, 263, 269, 275, 281, 291, 297, 305, 455, 521, 551, 575; **2(2):**807, 811, 817, 825, 837, 843, 847, 861, 875, 983, 1207, 1295, 1337
- South Carolina, USA—**1(1):**345, 665; **1(2):**1269; **2(2):**1279
- Southern Appalachian Mountains, USA—**2(1):**649
- Spartina—**2(1):**743
- Species area relationship—**2(2):**1363
- Species ratios (exotic/native)—**2(2):**1389
- Species richness—**1(1):**577; **2(2):**1363, 1373
- Spermacoce—**1(2):**1023
  - **burchellii**—**1(2):**1025
  - **crispata**—**1(2):**1025
  - **delicatula**—**1(2):**1025
  - **dimorpha**—**1(2):**1025
  - **incognita**—**1(2):**1025
  - **irwiniana**—**1(2):**1025
  - **multiflora**—**1(2):**1026
  - **paraensis**—**1(2):**1027
  - **pulchristipula**—**1(2):**1027
  - schumannii—**2(1):**305
  - **semiamplexicale**—**1(2):**1028
  - **spicata**—**1(2):**1028
  - **tocantinsiana**—**1(2):**1028
- Sphagnum bog—**1(1):**389
- Spiranthes brevilabris—**1(2):**1267
- Spiranthinae (Orchidaceae)—**1(2):**1001
- Stachys—**2(2):**761
  - **iltisii**—**2(2):**761
- Stipa speciosa—**2(1):**165
- Stipeae (Poaceae)—**2(1):**165
- Stuckenia filiformis subsp. **borealis—2(1):**433
- Succession—**1(2):**1141
- Symphyotrichum
  - pretense—**2(1):**731
  - sericeum—**2(1):**731
- *Synoptical Flora of North America*—**2(2):**1285
- Syrmatium—**2(1):**387

- **T**alamanca, Costa Rica—**2(1):**41
- Talinum rugospermum—**1(1):**777
- Tamaulipas, Mexico—**1(1):** 79, 511; **1(2):**933; **2(2):**917
- Taxaceae—**1(1):**203, 291
- Taxus—**1(1):**203, 291
  - **biternata—1(1):**266
  - brevifolia—**1(1):**291
    - var. **polychaeta—1(1):**217
    - var. **reptaneta—1(1):**219
  - caespitosa
    - var. **angustifolia—1(1):**268
    - var. **latifolia—1(1):**269
  - canadensis—**1(1):**291
    - var. **adpressa—1(1):**274
    - var. **minor—1(1):**274
  - contorta var. **mucronata—1(1):**260
  - **florinii—1(1):**222
  - globosa—**1(1):**291
    - var. **floridana—1(1):**224
  - **kingstonii—1(1):**240
  - mairei var. **speciosa—1(1):**246
  - **obscura—1(1):**235
  - **phytonii—1(1):**237
  - **suffnessii—1(1):**226
  - **umbraculifera**
    - var. **hicksii—1(1):**279
    - var. **microcarpa—1(1):**279
    - var. **nana—1(1):**281
- Tennessee, Inner Central (Nashville) Basin, USA—**1(2):**1131
- Tennessee, USA—**1(2):**1131; **2(2):**1309
- Ternstroemia gymnanthera—**2(1):**637
- Tertiary—**2(1):**463; **2(2):**1167
- Tetrazygia
  - elaeagnoides—**2(1):**35
  - longicollis—**2(1):**35
  - **paralongicollis—2(1):**35
- Texas, USA—**1(1):**679, 693, 717, 763, 779; **1(2):**1125, 1149, 1253, 1255, 1265, 1269; **2(1):**419, 651, 661, 665, 673, 677, 685, 741; **2(2):**1291, 1347, 1373, 1475, 1481, 1491, 1495, 1497
- Thamnocalamus
  - **chigar—1(1):**139
  - **nepalensis—1(1):**139
  - **occidentalis—1(1):**139
  - spathiflorus—**1(1):**135
- Thecagonum—**1(1):**373
  - **strigulosum—1(1):**377
- Thevetia
  - ahoua—**2(1):**489
  - sect. Ahouai—**2(1):**489
  - sect. Thevetia—**2(1):**489
- Thibaudia laurifolia—**2(1):**243
- Thicket—**2(1):**661
- Thomas Walter Typification Project—**1(1):**407, 425; **1(2):**1091; **2(1):**475; **2(2):**1279
- Threatened plant—**1(2):**815
- Thunbergia alata—**2(1):**637
- Thurovia—**1(1):**145
- Timucuan Ecological and Historic Preserve, Florida, USA—**1(2):**1157
- Tocantins, Brazil—**1(2):**1023; **2(1):**305, 455; **2(2):**983

- Tocoyena—**2(2):**983
  - **arenicola**—**2(2):**988
- Tournefortia—**2(1):**264
- Tracheid pits—**1(1):**449
- Transmexican Volcanic Belt—**2(1):**495
- Tree canopy—**2(2):**1309
- Tree climbing—**2(2):**1309
- **Trochanthera**—**2(2):**1168
  - **lepidota**—**2(2):**1168
- Type specimen catalogue—**1(1):**437

- **U**mpqua National Forest, USA—**1(1):**9
- University of British Columbia Herbarium—**1(1):**437
- Urban runoff—**1(1):**719
- Urticaceae—**2(2):**995
- USA—**1(1):**9, 29, 47, 59, 69, 103, 109, 171, 345, 351, 367, 369, 407, 425, 457, 483, 577, 585, 609, 631, 655, 665, 679, 693, 713, 717, 719, 741, 753, 763, 769, 777, 779; **1(2):**789, 1091, 1125, 1131, 1141, 1149, 1157, 1179, 1251, 1253, 1255, 1265, 1269; **2(1):**1, 419, 433, 447, 475, 627, 633, 637, 643, 649, 651, 661, 665, 673, 677, 685, 731, 741, 743; **2(2):**761, 771, 775, 1101, 1163, 1225, 1279, 1291, 1347, 1353, 1363, 1373, 1381, 1389, 1407, 1449, 1475, 1481, 1491, 1495, 1497
- Utricularia juncea—**2(2):**1353

- **V**accinieae (Ericaceae)—**2(1):**243, 249
- Vaccinium—**2(1):**207
  - **beamanianum**—**2(1):**219
  - **campanense**—**2(1):**234
  - **chihuahuense**—**2(1):**220
  - uliginosum subsp. **vulcanorum**—**2(1):**442
- Vahlodea latifolia subsp. **paramushirensis**—**2(1):**435
- Validation—**2(1):**677
- Varronia—**2(2):**837
  - bullata subsp. **humilis**—**2(2):**837
  - **cremersii**—**2(2):**838
  - **marioniae**—**2(2):**839
- Vegetation analysis—**1(1):**557
- Vegetation changes—**1(2):**1141
- Vegetation communities—**2(1):**685
- Vegetation zones—**1(2):**1131
- Vegetational areas—**2(2):**1373
- Venezuela—**2(1):**61, 75, 269, 275; **2(2):**1207
- Venezuelan Guayana—**2(1):**275; **2(2):**825
- Veracruz, Mexico—**2(2):**1009
- Verbena brasiliensis—**1(2):**1141
- Vicia
  - lathyroides—**1(2):**1253
  - sativa—**1(2):**1253
- Viola guadalupensis—**2(1):**677
- Violaceae—**2(1):**677
- Virginia, USA—**1(1):**367

- **W**aldsteinia—**2(1):**415
  - doniana—**2(1):**415
  - fragarioides
    - subsp. doniana—**2(1):**415
    - var. parviflora—**2(1):**415
  - parviflora—**2(1):**415
- Wechiau Community Hippotamus Sanctuary, Ghana—**1(1):**549
- Wechiau, Ghana—**1(1):**549
- West Indies—**1(2):**899; **2(1):**35, 95, 139, 267, 463; **2(2):**799, 1165, 1167
- Western Ghats, India—**1(1):**121, 129
- Wetlands—**1(1):**511, 719
  - Indicator status—**1(1):**719
  - Pine savannas—**2(2):**1475
  - Plant list—**1(1):**719
- White sands—**2(2):**983
- Wildland-urban interface—**1(1):**719; **2(1):**743
- Wissadula hernandioides—**1(2):**1255
- Witheringia—**2(1):**41
- Wyoming, USA—**2(2):**1225

- **X**eric sandylands—**2(2):**1475
- Xeromorphy—**2(2):**1101
- Xylothamia—**1(1):**145
- Xylovirgata—**1(1):**145
- Xyridaceae—**2(1):**1
- Xyris **panacea**—**2(1):**1

- **Y**azoo-Mississippi Delta Region, Mississippi, USA—**1(1):**769
- Yeatesia viridiflora—**2(2):**1353
- Yucatan Peninsula, Mexico—**2(2):**1009
- Yucca gloriosa—**2(2):**1353

- **Z**izania texana—**2(1):**673

454 NEW NAMES AND NEW COMBINATIONS: VOLUME 1 (2007) AND VOLUME 2 (2008)

- **Achillea alpina** subsp. **multiflora** (Hook.) D.F. Murray & Elven, comb. et stat. nov.—**2(1):**442
- **Acmispon americanus** var. **helleri** (Britton) Brouillet, comb. nov.—**2(1):**388
- **Acmispon argophyllus** (A. Gray) Brouillet, comb. nov.—**2(1):**388
- **Acmispon argophyllus** var. **adsurgens** (Dunkle) Brouillet, comb. nov.—**2(1):**388
- **Acmispon argophyllus** var. **argenteus** (Dunkle) Brouillet, comb. nov.—**2(1):**388
- **Acmispon argophyllus** var. **fremontii** (A. Gray) Brouillet, comb. nov.—**2(1):**389
- **Acmispon argyreus** (Greene) Brouillet, comb. nov.—**2(1):**389
- **Acmispon argyraeus** var. **multicaulis** (Ottley) Brouillet, comb. nov.—**2(1):**389
- **Acmispon argyraeus** var. **notitius** (Isely) Brouillet, comb. nov.—**2(1):**389
- **Acmispon cytisoides** (Benth.) Brouillet, comb. nov.—**2(1):**389

Acmispon dendroideus (Greene) Brouillet, comb. nov.—**2(1):**389
Acmispon dendroideus var. **traskiae** (Noddin) Brouillet, comb. nov.—**2(1):**389
Acmispon dendroideus var. **veatchii** (Greene) Brouillet, comb. nov.—**2(1):**389
Acmispon distichum (Greene) Brouillet, comb. nov.—**2(1):**389
Acmispon flexuosus (Greene) Brouillet, comb. nov.—**2(1):**389
Acmispon glabrus (Vogel) Brouillet, comb. nov.—**2(1):**389
Acmispon glabrus var. **brevialatus** (Ottley) Brouillet, comb. nov.—**2(1):**390
Acmispon grandiflorus (Benth.) Brouillet, comb. nov.—**2(1):**390
Acmispon grandiflorus var. **macranthus** (Greene) Brouillet, comb. nov.—**2(1):**390
Acmispon greenei (Wooton & Standl.) Brouillet, comb. nov.—**2(1):**390
Acmispon haydonii (Orcutt) Brouillet, comb. nov.—**2(1):**390
Acmispon heermannii (Greene) Brouillet, comb. nov.—**2(1):**390
Acmispon heermannii var. **orbicularis** (A. Gray) Brouillet, comb. nov.—**2(1):**390
Acmispon intricatus (Eastw.) Brouillet, comb. nov.—**2(1):**390
Acmispon junceus (Benth.) Brouillet, comb. nov.—**2(1):**391
Acmispon junceus var. **biolettii** (Greene) Brouillet, comb. nov.—**2(1):**391
Acmispon maritimus var. **brevivexillus** (Ottley) Brouillet, comb. nov.—**2(1):**391
Acmispon mearnsii (Britt.) Brouillet, comb. nov.—**2(1):**391
Acmispon mearnsii var. **equisolensis** (J.L. Anderson) Brouillet, comb. nov.—**2(1):**391
Acmispon micranthus (Nutt. ex Torr. & A. Gray) Brouillet, comb. nov.—**2(1):**391
Acmispon nevadensis (S. Watson) Brouillet, comb. nov.—**2(1):**391
Acmispon nevadensis var. **davidsonii** (Greene) Brouillet, comb. nov.—**2(1):**391
Acmispon niveus (S. Watson) Brouillet, comb. nov.—**2(1):**391
Acmispon nudatus (Watson) Brouillet, comb. nov.—**2(1):**391
Acmispon oroboides (Kunth) Brouillet, comb. nov.—**2(1):**391
Acmispon procumbens (Greene) Brouillet, comb. nov.—**2(1):**392
Acmispon procumbens var. **jepsonii** (Ottley) Brouillet, comb. nov.—**2(1):**392
Acmispon prostratus (Nutt. ex Torr. & A. Gray) Brouillet, comb. nov.—**2(1):**392
Acmispon rigidus (Benth.) Brouillet, comb. nov.—**2(1):**392
Acmispon strigosus (Nutt. ex Torr. & A. Gray) Brouillet, comb. nov.—**2(1):**392
Acmispon utahensis (Ottley) Brouillet, comb. nov.—**2(1):**392
Acmispon wrightii (A. Gray) Brouillet, comb. nov.—**2(1):**392
Agapetes acuminata var. **tipiensis** Banik & Sanjappa, var. nov.—**1(2):**903
Agapetes flava var. **nagensis** Banik & Sanjappa, var. nov.—**1(2):**905
Agapetes megacarpa var. **lohitensis** Banik & Sanjappa, var. nov.—**1(2):**905
Agapetes odontocera var. **mizoramensis** Banik & Sanjappa, var. nov.—**1(2):**908
Agapetes salicifolia var. **glanduliflora** Banik & Sanjappa, var. nov.—**1(2):**910
Agasthiyamalaia S. Rajkumar & Janarth., gen. nov.—**1(1):**130
Agasthiyamalaia pauciflora (Bedd.) S. Rajkumar & Janarth., comb. nov.—**1(1):**131
Agave montium-sancticaroli García-Mend., sp. nov.—**1(1):**79
Alocasia nycteris Medecilo, Yao & Madulid, sp. nov.—**1(2):**817
Anisocapparis X. Cornejo & H.H. Iltis, gen. nov.—**2(1):**62
Anisocapparis speciosa (Griseb.) X. Cornejo & H.H. Iltis, comb. nov.—**2(1):**65
Aphanelytrum peruvianum Sánchez Vega, P.M. Peterson, Soreng & Lægaard, sp. nov.—**1(2):**842
Arabidopsis petraea subsp. **septentrionalis** (N. Busch) Elven & D.F. Murray, comb. nov.—**2(1):**438
Arabidopsis petraea subsp. **umbrosa** (Turcz. ex Steud.) Elven & D.F. Murray, comb. nov.—**2(1):**439
Aristida sorzogonensis f. **orizabensis** (E. Fourn.) Strahan & Allred, comb. nov.—**2(1):**322
Aristolochia kanukuensis Feuillet, sp. nov.—**1(1):**143
Artemisia kruhsiana subsp. **alaskana** (Rydb.) D.F. Murray & Elven, comb. et stat. nov.—**2(1):**443
Asplenium tutwilerae B.R. Keener & L.J. Davenport, sp. nov.—**1(1):**104
Baccharis apicifoliosa A.A. Schneid. & Boldrini, sp. nov.—**2(1):**45
Baccharis flexuosiramosa A.A. Schneid. & Boldrini, sp. nov.—**2(1):**48
Besleria neblinae Feuillet, sp. nov.—**2(1):**269
Besleria yatuana Feuillet, sp. nov.—**2(1):**271
Bistorta elliptica (Willd. ex Spreng.) V.V. Petrovsky, D.F. Murray & Elven, comb. nov.—**2(1):**435
Boerhavia triquetra var. **intermedia** (M.E. Jones) Spellenb., comb. nov.—**1(2):**874
Bouteloua tamaulipensis G.J. Pierce ex D. Pacheco & Columbus, sp. nov.—**2(2):**966
Calamagrostis purpurascens subsp. **laricina** (Louis-Marie) Elven, comb. et stat. nov.—**2(1):**434
Calyptranthes websteri B. Holst & M.L. Kawasaki, sp. nov.—**2(1):**297
Carex billingsii (O.W. Knight) C.D. Kirschbaum, comb. et stat. nov.—**1(1):**401
Carex klamathensis B.L. Wilson & L.P. Janeway, sp. nov.—**1(1):**71

Chusquea annagardneriae L.G. Clark, C.D. Tyrrell, Triplett & A.E. Fisher, sp. nov.—**1(2):**847
Colicodendron bahianum X. Cornejo & H.H. Iltis, sp. nov.—**2(1):**76
Colicodendron valerabellum H.H. Iltis, T. Ruiz & G.S. Bunting, sp. nov.—**2(1):**82
Coptidium × spitsbergense (Hadac) Elven, comb. nov.—**2(1):**437
Cotoneaster floridus J. Fryer & B. Hylmö, sp. nov.—**2(1):**55
Cotoneaster qungbixiensis J. Fryer & B. Hylmö, sp. nov.—**2(1):**53
Cotoneaster series **Sterniani** J. Fryer & B. Hylmö, ser. nov.—**2(1):**53
Crataegus series **Apricae** J.B. Phipps, ser. nov.—**1(1):**173
Crataegus aquacervensis J.B. Phipps & O'Kennon, sp. nov.—**1(2):**1061
Crataegus brazoria var. **viburnifolia** (Sarg.) J.B. Phipps, comb. nov.—**1(2):**1007
Crataegus chrysocarpa var. **blanchardii** (Sarg.) J.B. Phipps, comb. et stat. nov.—**1(2):**1009
Crataegus chrysocarpa var. **praecox** (Sarg.) J.B. Phipps, comb. et stat. nov.—**1(2):**1009
Crataegus chrysocarpa var. **vigintistamina** J.B. Phipps, var. nov.—**1(2):**1008
Crataegus coccinea var. **pringlei** (Sarg.) J.A. Macklin & J.B. Phipps, comb. et stat. nov.—**1(2):**1005
Crataegus cupressocollina J.B. Phipps & O'Kennon, sp. nov.—**1(2):**1056
Crataegus series **Cupressocollinae** J.B. Phipps & O'Kennon, ser. nov.—**1(2):**1056
Crataegus lancei J.B Phipps, sp. nov.—**2(2):**1143
Crataegus mollis var. **incisifolia** Kruschke, var. nov.—**1(2):1012; 2(1):**473
Crataegus series **Montaninsulae** J.B. Phipps & O'Kennon, ser. nov.—**1(2):**1065
Crataegus pruinosa var. **dissona** (Sarg.) J.B. Phipps, comb. et stat. nov.—**1(2):**1007
Crataegus purpurella J.B. Phipps & O'Kennon, sp. nov.—**1(2):**1066
Crataegus reverchonii var. **mohrii** (Beadle) J.B. Phipps, comb. et stat. nov.—**1(2):**1006
Crataegus rivuloadamensis J.B. Phipps & O'Kennon, sp. nov.—**1(2):**1065
Crataegus rivulopugnensis J.B. Phipps & O'Kennon, sp. nov.—**1(2):**1070
Crataegus rubribracteolata J.B. Phipps & O'Kennon, sp. nov.—**1(2):**1073
Crataegus schuettei var. **gigantea** Kruschke, var. nov.—**1(2):1013; 2(1):**473
Crataegus sheila-phippsiae var. **saskatchewanensis** J.B. Phipps & O'Kennon, var. nov.—**1(2):**1079
Crataegus ursopedensis J.B.Phipps & O'Kennon, sp. nov.—**1(2):**1081
Crataegus viridis var. **velutina** (Sarg.) J.B. Phipps, comb. et stat. nov.—**1(2):**1009
Cretacifilix G.O. Poinar & R. Buckley, gen. nov.—**2(2):**1176
Cretacifilix fungiformis G.O. Poinar & R. Buckley, sp. nov.—**2(2):**1176
Cuatresia amistadensis D.A. Soto & A.K. Monro, sp. nov.—**2(1):**41
Cyclopogon secundum Christenson, sp. nov.—**1(2):**1001
Cyperus karthikeyanii Wad. Khan & Lakshmin., sp. nov.—**2(1):**379
Dicerandra modesta (Huck) Huck, comb. et stat. nov.—**2(2):**1163
Diospyros acapulcensis subsp. **chiquimulensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**2(2):**1025
Diospyros acapulcensis subsp. **dwyeri** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**2(2):**1027
Diospyros acapulcensis subsp. **guanacastensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**2(2):**1029
Diospyros acapulcensis subsp. **mejocotensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**2(2):**1031
Diospyros acapulcensis subsp. **nicaraguensis** (Standl.). M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov.—**2(2):**1033
Diospyros acapulcensis subsp. **pedromorenoi** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**2(2):**1036
Diospyros acapulcensis subsp. **rivensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**2(2):**1039
Diospyros acapulcensis subsp. **veraecrucis** (Standl.) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov.—**2(2):**1044
Diospyros aequoris subsp. **balsensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**2(2):**1061
Diospyros aequoris subsp. **chutlensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**2(2):**1065
Diospyros aequoris subsp. **martineziana** (Standl. ex Leavenworth) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov.—**2(2):**1069
Diospyros aequoris subsp. **rekoi** (Standl.) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov.—**2(2):**1071
Diospyros aequoris subsp. **tehuantepecensis** M.C. Provance, I. García & A.C. Sanders, subsp. nov.—**2(2):**1074
Diospyros yucatanensis subsp. **spectabilis** (Lundell) M.C. Provance, I. García & A.C. Sanders, comb. et stat. nov.—**2(2):**1086
Doryopteris jequitinhonhensis Salino, sp. nov.—**2(2):**843
Dryas punctata subsp. **hookeriana** (Juz.) Jurtz., comb. nov.—**2(1):**441
Drymocallis campanulata (C.L. Hitchc.) Ertter, stat. et comb. nov.—**1(1):**43
Drymocallis cuneifolia var. **ewanii** (D.D. Keck) Ertter, stat. et comb. nov.—**1(1):**44
Drymocallis deseretica Ertter, sp. nov.—**1(1):**41
Drymocallis glandulosa var. **reflexa** (Greene) Ertter, comb. nov.—**1(1):**43
Drymocallis glandulosa var. **viscida** (Parish) Ertter, stat. et comb. nov.—**1(1):**43
Drymocallis glandulosa var. **wrangelliana** (Fisch. & Avé-Lall.) Ertter, comb. nov.—**1(1):**43
Drymocallis lactea var. **austiniae** (Jeps.) Ertter, comb. nov.—**1(1):**36
Drymocallis pseudorupestris var. **crumiana** D.D. Keck ex Ertter, var. nov.—**1(1):**39

Drymocallis pseudorupestris var. **saxicola** Ertter, var. nov.—**1(1):**37
Dudleya abramsii subsp. **costifolia** (Bartel & Shevock) Moran, comb. nov.—**1(2):**1015
Dudleya abramsii subsp. **setchellii** (Jeps.) Moran, comb. nov.—**1(2):**1015
Dysphania andicola (Phil.) Mosyakin & Clemants, comb. nov.—**2(1):**428
Dysphania bonariensis (Hook. f.) Mosyakin & Clemants, comb. nov.—**2(1):**428
Dysphania burkartii (Aellen) Mosyakin & Clemants, comb. nov.—**2(1):**428
Dysphania congolana (Hauman) Mosyakin & Clemants, comb. nov.—**2(1):**429
Dysphania dissecta (Moq.) Mosyakin & Clemants, comb. nov.—**2(1):**429
Dysphania dunosa (L.E. Simón) Mosyakin & Clemants, comb. nov.—**2(1):**428
Dysphania mandonii (S. Watson) Mosyakin & Clemants, comb. nov.—**2(1):**429
Dysphania melanocarpa (J.M. Black) Mosyakin & Clemants, comb. nov.—**2(1):**427
Dysphania microcarpa (Phil.) Mosyakin & Clemants, comb. nov.—**2(1):**428
Dysphania minuata (Aellen) Mosyakin & Clemants, comb. nov.—**2(1):**429
Dysphania nepalensis (Colla) Mosyakin & Clemants, comb. nov.—**2(1):**428
Dysphania oblanceolata (Speg.) Mosyakin & Clemants, comb. nov.—**2(1):**428
Dysphania procera (Hochst. ex Moq.) Mosyakin & Clemants, comb. nov.—**2(1):**429
Dysphania pusilla (Hook. f.) Mosyakin & Clemants, comb. nov.—**2(1):**427
Dysphania retusa (Juss. ex Moq.) Mosyakin & Clemants, comb. nov.—**2(1):**428
Dysphania saxatilis (P.G. Wilson) Mosyakin & Clemants, comb. nov.—**2(1):**427
Dysphania sooana (Aellen) Mosyakin & Clemants, comb. nov.—**2(1):**428
Dysphania stellata (Standley) Mosyakin & Clemants, comb. nov.—**2(1):**429
Dysphania tomentosa (Thouars) Mosyakin & Clemants, comb. nov.—**2(1):**428
Dysphania truncata (P.G. Wilson) Mosyakin & Clemants, comb. nov.—**2(1):**427
Dysphania venturii (Aellen) Mosyakin & Clemants, comb. nov.—**2(1):**428
Eleocharis acutangula subsp. **breviseta** D.J. Rosen, subsp. nov.—**1(2):**885
Eleocharis acutangula subsp. **neotropica** D.J. Rosen, subsp. nov.—**1(2):**886
Eoëpigynia Poinar, Chambers & Buckley, gen. nov.—**1(1):**92
Eoëpigynia burmensis Poinar, Chambers & Buckley, sp. nov.—**1(1):**92
Episcia duidae Feuillet, sp. nov.—**2(1):**275
Episcia rubra Feuillet, sp. nov.—**2(1):**277
Equisetum arvense subsp. **alpestre** (Wahlenb.) Schönswetter & Elven, comb. et stat. nov.—**2(1):**433
Erigeron heleniae Nesom, sp. nov.—**1(2):**891
Eugenia concava B. Holst & M.L. Kawasaki, sp. nov.—**2(1):**299
Festuca ×gonzalez-ledesmae S.J. Darbyshire, nothosp. nov.—**1(2):**832
Eugenia grossa B. Holst & M.L. Kawasaki, sp. nov.—**2(1):**299
Festuca longiligula S.J. Darbyshire, sp. nov.—**1(2):**827
Festuca ×miscella S.J. Darbyshire, nothosp. nov.—**1(2):**835
Festuca roemeri var. **klamathensis** B.L. Wilson, var. nov.—**1(1):**59
Fimbristylis naikii Wad. Khan & Lakshmin., sp. nov.—**2(1):**381
Gaylussacia bigeloviana (Fernald) Sorrie & Weakley, comb. nov.—**1(1):**336
Gentianopsis barbata subsp. **raupii** (A.E. Porsild) Elven, comb. nov.—**2(1):**442
Geum donianum (Tratt.) Weakley & Gandhi, comb. nov.—**2(1):**417
Gratiola graniticola D. Estes, sp. nov.—**1(1):**166
Gratiola quartermaniae D. Estes, sp. nov.—**1(1):**163
Guadua chaparensis Londoño & Zurita, sp. nov.—**2(1):**31
Guadua incana Londoño, sp. nov.—**2(1):**26
Gutierrezia elegans Al Schneider & P. Lyon, sp. nov.—**2(2):**771
Hedyotis ekmanii Alain, nom. nov.—**2(2):**1165
Hedysarum boreale subsp. **dasycarpum** (Turcz.) D.F. Murray & Elven, comb. et stat. nov.—**2(1):**441
Heterotheca arizonica (Semple) Nesom, comb. et stat. nov.—**1(1):**27
Heterotheca nitidula (Woot. & Standl.) Nesom, comb. nov.—**1(1):**24
Heuchera woodsiaphila P.J. Alexander, sp. nov.—**2(1):**448
Himalayacalamus planatus Stapleton, sp. nov.—**1(1):**137
Hosackia crassifolia var. **otayensis** (Moran ex Isely) Brouillet, comb. nov.—**2(1):**388
Hosackia oblongifolia var. **cuprea** (Greene) Brouillet, comb. nov.—**2(1):**388
Hosackia stipularis var. **ottleyi** (Isely) Brouillet, comb. nov.—**2(1):**388
Houstonia subg. **Porotis** Terrell, subg. nov.—**1(1):**117
Humboldtia brunonis var. **raktapushpa** P.S. Udayan, K.V. Tushar & Satheesh George, var. nov.—**1(1):**121
Illicium guajaibonense (Imkhanitskaya) Judd & Abbott, comb. et stat. nov.—**2(2):**800
Ipomoea tehuantepecensis L. Torres-Colín, R. Torres-Colín, M.P. Ramírez & J.A. McDonald, sp. nov.—**2(2):**793
Ixora araguaiensis Delprete, sp. nov.—**2(1):**456
Ixora congestiflora Delprete, sp. nov.—**2(1):**456
Ixora irwinii Delprete, sp. nov.—**2(1):**459
Juncus digitatus C. Witham & Zika, sp. nov.—**2(2):**775
Kalmiopsis fragrans Meinke & Kaye, sp. nov.—**1(1):**10
Koeleria pyramidata subsp. **seminuda** (Trautv.) Elven, comb. nov.—**2(1):**434
Kohleria hypertrichosa J.L. Clark & L.E. Skog, sp. nov.—**2(1):**20

Lachnociona G.O. Poinar, K.L. Chambers & R. Buckley, gen. nov.—**2(2):**1184
Lachnociona terriae G.O. Poinar, K.L. Chambers & R. Buckley, sp. nov.—**2(2):**1184
Lasiambix Poinar, Chambers & Brown, gen. nov.—**2(1):**464
Lasiambix dominicensis Poinar, Chambers & Brown, sp. nov.—**2(1):**464
Lasiolaena lychnophorioides Roque & H. Rob., sp. nov.—**2(2):**812
Lechea pulchella var. **ramosissima** (Hodgdon) Sorrie & Weakley, comb. nov.—**1(1):**370
Limnanthes alba subsp. **gracilis** (Howell) Morin, comb. et stat. nov.—**1(2):**1017
Limnanthes alba subsp. **parishii** (Jeps.) Morin, comb. et stat. nov.—**1(2):**1017
Limnanthes douglasii subsp. **striata** (Jeps.) Morin, comb. et stat. nov.—**1(2):**1017
Limnorchis aquilonis (Sheviak) Rebrist. & Elven, comb. nov.—**2(1):**434
Limnorchis huronensis (Nutt.) Rebrist. & Elven, comb. nov.—**2(1):**434
Lobelia gloria-montis subsp. **longibracteata** (Rock) Lammers, stat. nov.—**1(2):**806
Lobelia ×kauaiensis (A. Gray) A. Heller, stat. nov.—**1(2):**801
Lobelia koolauensis (Hosaka & Fosberg) Lammers, comb. et stat. nov.—**1(2):**803
Lobelia wahiawa Lammers, sp. nov.—**1(2):**802
Mandevilla aequatorialis J.F. Morales, sp. nov.—**1(2):**853
Mandevilla frigida J.F. Morales, sp. nov.—**1(2):**855
Mandevilla horrida J.F. Morales, sp. nov.—**1(2):**863
Mandevilla inexperata J.F. Morales, sp. nov.—**1(2):**865
Mandevilla lojana J.F. Morales, sp. nov.—**1(2):**855
Mandevilla megabracteata J.F. Morales, sp. nov.—**1(2):**866
Mandevilla similaris J.F. Morales, sp. nov.—**1(2):**867
Matelea costata var. **goodfriendii** (Proctor) Krings, comb. nov.—**2(1):**150
Matelea dictyopetala (Urb. & Ekman) Krings, comb. nov.—**2(1):**130
Matelea proctori Krings, nom. nov.—**2(1):**151
Matelea pubescens (Griseb.) Krings, comb. nov.—**2(1):**131
Medranoa johnstonii (G.L. Nesom) G.L. Nesom, comb. nov.—**1(1):**148
Medranoa palmeri (A. Gray) G.L. Nesom, comb. nov.—**1(1):**148
Medranoa pseudobaccharis (S.F. Blake) G.L. Nesom, comb. nov.—**1(1):**148
Medranoa purpusii (Brandeg.) G.L. Nesom, comb. nov.—**1(1):**148
Meliosma antioquiensis X. Cornejo, sp. nov.—**2(1):**57
Micranthes bryophora (A. Gray) Brouillet & Gornall, comb. nov.—**1(2):**1020
Micranthes calycina (Sternb.) Gornall & H. Ohba, comb. nov.—**1(2):**1020
Micranthes ferruginea (Graham) Brouillet & Gornall, comb. nov.—**1(2):**1020
Micranthes foliolosa (R. Br.) Gornall, comb. nov.—**1(2):**1020
Micranthes gormanii (Suksd.) Brouillet & Gornall, comb. nov.—**1(2):**1020
Micranthes hieraciifolia subsp. **longifolia** (Engl. & Irmsch.) Elven & D.F. Murray, comb. nov.—**2(1):**439
Micranthes idahoensis (Piper) Brouillet & Gornall, comb. nov.—**1(2):**1020
Micranthes lyallii subsp. **hultenii** (Calder & Savile) Elven & D.F. Murray, comb. nov.—**2(1):**440
Micranthes merkii (Fisch. ex Sternb.) Elven & D.F. Murray, comb. nov.—**2(1):**440
Micranthes mexicana (Engl. & Irmsch.) Brouillet & Gornall, comb. nov.—**1(2):**1020
Micranthes nelsoniana subsp. **aestivalis** (Fisch. & C.A. Mey.) Elven & D.F. Murray, comb. nov.—**2(1):**440
Micranthes nelsoniana subsp. **insularis** (Hultén) Elven & D.F. Murray, comb. nov.—**2(1):**440
Micranthes nelsoniana var. **aestivalis** (Fisch. & C.A. Mey.) Gornall & H. Ohba, comb. et stat. nov.—**1(2):**1020
Micranthes nelsoniana var. **carlottae** (Calder & Savile) Gornall & H. Ohba, comb. et stat. nov.—**1(2):**1020
Micranthes nelsoniana var. **cascadensis** (Calder & Savile) Gornall & H. Ohba, comb. et stat. nov.—**1(2):**1020
Micranthes nelsoniana var. **insularis** (Hultén) Gornall & H. Ohba, comb. et stat. nov.—**1(2):**1020
Micranthes nelsoniana var. **pacifica** (Hultén) Gornall & H. Ohba, comb. et stat. nov.—**1(2):**1020
Micranthes nelsoniana var. **porsildiana** (Calder & Savile) Gornall & H. Ohba, comb. nov.—**2(1):**395
Micranthes nudicaulis (D. Don) Gornall & H. Ohba, comb. nov.—**1(2):**1021
Micranthes petiolaris (Raf.) Brouillet & Gornall, comb. nov.—**1(2):**1021
Micranthes porsildiana (Calder & Savile) Elven & D.F. Murray, comb. nov.—**2(1):**440
Micranthes razshivinii (P. Yu. Zhmylev) Brouillet & Gornall, comb. nov.—**1(2):**1021
Micranthes redofskyi (Adams) Elven & D.F. Murray, comb. nov.—**2(1):**441
Micranthes tempestiva (Elvander & Denton) Brouillet & Gornall, comb. nov.—**1(2):**1021
Micranthes tischii (Skelly) Brouillet & Gornall, comb. nov.—**1(2):**1021
Micranthes tolmiei (Torrey & A. Gray) Brouillet & Gornall, comb. nov.—**1(2):**1022
Micranthes unalaschcensis (Sternb.) Gornall & H. Ohba, comb. nov.—**1(2):**1022
Monilicarpa X. Cornejo & H.H. Iltis, gen. nov.—**2(1):**67
Monilicarpa brasiliana (Banks ex DC.), X. Cornejo & H.H. Iltis, comb. nov.—**2(1):**71
Monilicarpa tenuisiliqua (Jacq.) X. Cornejo & H.H. Iltis, comb. nov.—**2(1):**70
Mosiera androsiana (Urban) Salywon, comb. nov.—**1(2):**899
Mosiera cuspidata (Alain) Salywon, comb. nov.—**1(2):**899
Mosiera gracilipes (Alain) Salywon, comb. nov.—**1(2):**899
Mosiera xerophytica (Britton) Salywon, comb. nov.—**1(2):**900
Munrochloa M. Kumar & Remesh, gen. nov.—**2(1):**374

Munrochloa ritchiei (Munro) M. Kumar & Remesh, comb. nov.—**2(1)**:376
Myrcia subcordifolia B. Holst & M.L. Kawasaki, sp. nov.—**2(1)**:303
Myriopus candidulus (Miers) Feuillet, comb. nov.—**2(1)**:264
Myriopus maculatus (Jacq.) Feuillet, comb. nov.—**2(1)**:264
Myriopus paniculatus (Chamisso) Feuillet, comb. nov.—**2(1)**:264
Myriopus paniculatus var. **spigeliiflorus** (A. DC.) Feuillet, comb. nov.—**2(1)**:264
Nautilocalyx crenatus Feuillet, sp. nov.—**2(2)**:825
Nautilocalyx orinocensis Feuillet, sp. nov.—**2(2)**:833
Nautilocalyx paujiensis Feuillet, sp. nov.—**2(2)**:827
Nautilocalyx pusillus Feuillet, sp. nov.—**2(2)**:827
Nautilocalyx roseus Feuillet, sp. nov.—**2(2)**:830
Nautilocalyx ruber Feuillet, sp. nov.—**2(2)**:830
Nautilocalyx vestitus Feuillet, sp. nov.—**2(2)**:833
Nemacladus australis (Munz) Morin, comb. et stat. nov.—**2(1)**:398
Nemacladus calcaratus Morin, sp. nov.—**2(1)**:399
Nemacladus californicus (A. Gray) Morin, comb. nov.—**2(1)**:397
Nemacladus orientalis (McVaugh) Morin, comb. et stat. nov.—**2(1)**:398
Nemacladus secundiflorus var. **robbinsii** Morin, var. nov.—**2(1)**:399
Nemacladus tenuis (McVaugh) Morin, comb. et stat. nov.—**2(1)**:398
Nemacladus tenuis var. **aliformis** Morin, var. nov.—**2(1)**:398
Neocalyptrocalyx morii X. Cornejo & H.H. Iltis, sp. nov.—**2(2)**:807
Orthaea laurifolia (M. Martens & Galeotti) Luteyn, comb. nov.—**2(1)**:244
Pachyphyllum sect. **Capitulum** E.A. Christ. sect. nov.—**2(1)**:288
Pachyphyllum sect. **Orchidotypum** (Kraenzl.) E.A. Christ., stat. nov.—**2(1)**:287
Packera hyperborealis subsp. **wrangelica** (Jurtz., Korobkov & V.V. Petrovsky) Jurtz., Korobkov & V.V. Petrovsky, comb. nov.—**2(1)**:443
Papaver labradoricum (Fedde) Solstad & Elven, comb. et stat. nov.—**2(1)**:438
Pappostipa (Speg.) Romaschenko, P.M. Peterson & Soreng, comb. et stat. nov—**2(1)**:181
Pappostipa ameghinoi (Speg.) Romaschenko, comb. nov.—**2(1)**:184
Pappostipa ameghinoi var. **digona** (Parodi) Romaschenko, comb. nov.—**2(1)**:184
Pappostipa ameghinoi var. **precordillerana** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:184
Pappostipa atacamensis (Parodi) Romaschenko, comb. nov.—**2(1)**:184
Pappostipa barrancaensis (F.A. Roig) Romaschenko, comb. nov.— **2(1)**:184; **2(2)**:**1233**
Pappostipa braun-blanquetii (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183
Pappostipa chrysophylla (E. Desv.) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa chrysophylla var. **cordillerarum** (Parodi) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa chrysophylla var. **crispula** (Kuntze) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa chrysophylla f. **minuta** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa chrysophylla f. **modica** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa sect. **Chrysovaginatae** Romaschenko, sect. nov.—**2(1)**:184
Pappostipa chubutensis (Speg.) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa chubutensis var. **hirsutissima** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa frigida (Phil.) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa frigida var. **parvispicula** (Parodi) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa hieronymusii (Pilg.) Romaschenko, comb. nov.—**2(1)**:183
Pappostipa humilis (Cav.) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa humilis var. **decrescens** (Kuntze) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa humilis var. **ruiziana** (Parodi) Romaschenko, comb. nov.—**2(1)**:185
Pappostipa ibarii (Phil.) Romaschenko, comb. nov.—**2(1)**:184
Pappostipa ibarii var. **anomala** (Parodi) Romaschenko, comb. nov.—**2(1)**:184
Pappostipa ibarii f. **pallescens** (Parodi) Romaschenko, comb. nov.—**2(1)**:184
Pappostipa maeviae (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183
Pappostipa major (Speg.) Romaschenko, comb. et stat. nov.—**2(1)**:184
Pappostipa malalhuensis (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183
Pappostipa nana (Speg.) Romaschenko, comb. nov.—**2(1)**:184
Pappostipa nicorae (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183
Pappostipa sect. **Pappostipa,** sect. nov.—**2(1)**:182
Pappostipa parodiana (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183
Pappostipa patagonica (Speg.) Romaschenko, comb. nov.—**2(1)**:183
Pappostipa ruiz-lealii (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183
Pappostipa semperiana (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183
Pappostipa sorianoi (Parodi) Romaschenko, comb. nov.—**2(1)**:184

Pappostipa speciosa (Trin. & Rupr.) Romaschenko, comb. nov.—**2(1)**:182

Pappostipa speciosa f. **abscondita** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:182

Pappostipa speciosa var. **atuelensis** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:182

Pappostipa speciosa var. **breviglumis** (Parodi) Romaschenko, comb. nov.—**2(1)**:182

Pappostipa speciosa var. **ciliata** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:182

Pappostipa speciosa f. **horrida** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:182

Pappostipa speciosa var. **manqueclensis** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:182

Pappostipa speciosa var. **media** (Torres) Romaschenko, comb. nov.—**2(1)**:182

Pappostipa speciosa var. **parva** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:182

Pappostipa vaginata (Phil.) Romaschenko, comb. nov.—**2(1)**:182

Pappostipa vaginata var. **argyroidea** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183

Pappostipa vaginata f. **contracta** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183

Pappostipa vaginata var. **dilatata** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183

Pappostipa vaginata f. **inmersa** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183

Pappostipa vaginata f. **laevis** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183

Pappostipa vaginata f. **rigida** (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:183

Pappostipa vatroensis (F.A. Roig) Romaschenko, comb. nov.—**2(1)**:184

Passiflora angusta Feuillet & J.M. MacDougal, sp. nov.—**2(2)**:818

Passiflora arta Feuillet, sp. nov.—**1(2)**:819

Passiflora compar Feuillet, sp. nov.—**1(2)**:821

Passiflora davidii Feuillet, sp. nov.—**1(2)**:896

Passiflora foetida var. **orinocensis** (Killip) Feuillet, stat. nov.—**1(1)**:144

Passiflora insueta Feuillet & MacDougal, nom. nov.—**2(1)**:267

Passiflora rufa Feuillet & J.M. MacDougal, sp. nov.—**2(2)**:822

Passiflora tecta Feuillet, sp. nov.—**2(1)**:281

Passiflora sect. **Trematanthera** (Leeuwenb.) Feuillet, sect. nov.—**2(1)**:277

Philadelphus microphyllus var. **argyrocalyx** (Wooton) Henrickson, comb. & stat. nov.—**1(2)**:901

Philadelphus microphyllus var. **madrensis** (Hemsley) Henrickson, comb. & stat. nov.—**1(2)**:901

Philadelphus microphyllus var. **stramineus** (Rydb.) Henrickson, comb. & stat. nov.—**1(2)**:901

Phragmites australis subsp. **berlandieri** (E. Fourn.) Saltonstall & Hauber, comb. nov.—**1(1)**:387

Pilea alfaroana Al. Rodr. & A.K. Monro, sp. nov.—**2(2)**:995

Pilea gamboana Al. Rodr. & A.K. Monro, sp. nov.—**2(2)**:997

Pilea herrerae Al. Rodr. & A.K. Monro, sp. nov.—**2(2)**:1000

Pilea longibracteolata Al. Rodr., A.K. Monro & L. Acosta, sp. nova.—**2(2)**:1002

Pilea moragana Al. Rodr. & A.K. Monro, sp. nov.—**2(2)**:1004

Poa pfisteri Soreng, sp. nov.—**2(2)**:850

Potentilla anserina subsp. **yukonensis** (Hultén) Soják ex Elven & D.F. Murray, comb. nov.—**2(1)**:441

Potentilla arenosa subsp. **chamissonis** (Hultén) Elven & D.F. Murray, comb. nov.—**1(2)**:813

Potentilla demotica Ertter, sp. nov.—**1(1)**:53

Potentilla holmgrenii D.F. Murray & Elven, sp. nov.—**1(2)**:811

Potentilla hyparctica subsp. **elatior** (Abrom.) Elven & D.F. Murray, comb. nov.—**1(2)**:813

Potentilla jepsonii Ertter, nom. nov.—**2(1)**:202

Potentilla rhyolitica Ertter, sp. nov.—**1(1)**:50

Potentilla rhyolitica var. **chiricahuensis** Ertter, var. nov.—**1(1)**:52

Puccinellia phryganodes subsp. **neoarctica** (Á. Löve & D. Löve) Elven, comb. et stat. nov.—**2(1)**:435

Puccinellia phryganodes subsp. **sibirica** (Hadac & Á. Löve) Elven, comb. nov.—**2(1)**:435

Pycnanthemum sect. **Californicae** K.L. Chambers & H.L. Chambers, sect. nov.—**2(1)**:195

Raddiella vanessiae Judz., sp. nov.—**1(1)**:1

Ranunculus subborealis subsp. **pumilus** (Wahlenb.) Elven, comb. nov.—**2(1)**:437

Ranunculus subborealis subsp. **villosus** (Drabble) Elven, comb. et stat. nov.—**2(1)**:438

Rhododendron tomentosum subsp. **decumbens** Elven & D.F. Murray, comb. nov.—**2(1)**:441

Ribes oxyacanthoides var. **cognatum** (Greene) Morin, comb. et stat. nov.—**1(2)**:1015

Rosaceae tribus **Lyonothamneae** Brouillet, tribus nov.—**2(1)**:385

Rosaceae subseries **Robustae** J.B. Phipps, subser. nov.—**2(2)**:1124

Rosaceae subseries **Tenues** J.B. Phipps, subser. nov.—**2(2)**:1108

Salvia toaensis Alain, nom. nov.—**2(2)**:1165

Scorzoneroides autumnalis subsp. **pratensis** (Hornem.) Elven, comb. nov.—**2(1)**:443

Sedum lanceolatum var. **subalpinum** (Fröd.) H. Ohba, comb. & stat. nov.—**1(2)**:890

Sedum laxum var. **eastwoodiae** (Britton) H. Ohba, comb. & stat. nov.—**1(2)**:889

Sedum laxum var. **flavidum** (Denton) H. Ohba, comb. & stat. nov.—**1(2)**:889

Sedum laxum var. **heckneri** (M. Peck) H. Ohba, comb. & stat. nov.—**1(2)**:889

Sedum laxum var. **latifolium** (R.T. Clausen) H. Ohba, comb. & stat. nov.—**1(2)**:890

Sedum obtusatum var. **boreale** (R.T. Clausen) H. Ohba, comb. & stat. nov.—**1(2)**:889

Sedum obtusatum var. **paradisum** (Denton) H. Ohba, comb. & stat. nov.—**1(2)**:889

Sedum obtusatum var. **retusum** (Rose) H. Ohba, comb. & stat. nov.—**1(2)**:889

Sedum oreganum var. **tenue** (R.T. Clausen) H. Ohba, comb. & stat. nov.—**1(2):**890
Sedum radiatum var. **ciliosum** (Howell) H. Ohba, comb. & stat. nov.—**1(2):**889
Sedum radiatum var. **depauperatum** (R.T. Clausen) H. Ohba, comb. & stat. nov.—**1(2):**889
Sedum stenopetalum var. **monanthum** (Suksd.) H. Ohba, comb. & stat. nov.—**1(2):**890
Sedum wrightii var. **densiflorum** (R.T. Clausen) H. Ohba, comb. & stat. nov.—**1(2):**889
Sedum wrightii var. **priscum** (R.T. Clausen) H. Ohba, comb. & stat. nov.—**1(2):**889
Sidalcea hickmanii subsp. **napensis** S.R. Hill, subsp. nov.—**2(2):**783
Sidalcea hickmanii subsp. **pillsburiensis** S.R. Hill, subsp. nov.—**2(2):**786
Silene involucrata subsp. **furcata** (Raf.) V.V. Petrovsky & Elven, comb. et stat. nov.—**2(1):**436
Silene soczavana var. **macrosperma** (A.E. Porsild) V.V. Petrovsky, D.F. Murray & Elven, comb. et stat. nov.—**2(1):**436
Silene villosula (Trautv.) V.V. Petrovsky & Elven, comb. nov.—**2(1):**437
Silene violascens (Tolm.) V.V. Petrovsky & Elven, comb. nov.—**2(1):**437
Siphonandra nervosa Luteyn & E.M. Ortiz, sp. nov.—**2(1):**256
Siphonandra santa-barbarense Luteyn & E.M. Ortiz, sp. nov.—**2(1):**256
Solidago multiradiata subsp. **arctica** (DC.) Korobkov & Elven, comb. et stat. nov.—**2(1):**443
Spermacoce burchellii (E.L. Cabral & Bacigalupo) Delprete, comb. nov.—**1(2):**1025
Spermacoce crispata (K. Schum.) Delprete, comb. nov.—**1(2):**1025
Spermacoce delicatula (E.L. Cabral) Delprete, comb. nov.—**1(2):**1025
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Spermacoce multiflora (DC.) Delprete, comb. nov.—**1(2):**1026
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Spermacoce semiamplexicale (E.L. Cabral) Delprete, comb. nov.—**1(2):**1028
Spermacoce spicata (Miq.) Delprete, comb. nov.—**1(2):**1028
Spermacoce tocantinsiana (E.L. Cabral & Bacigalupo) Delprete, comb. nov.—**1(2):**1028
Stachys iltisii J. Nelson, sp. nov.—**2(2):**761
Stuckenia filiformis subsp. **borealis** (Raf.) Tzvelev & Elven, comb. nov.—**2(1):**433
Taxus biternata Spjut, sp. nov.—**1(1):**266
Taxus brevifolia var. **polychaeta** Spjut, var. nov.—**1(1):**217
Taxus brevifolia var. **reptaneta** Spjut, var. nov.—**1(1):**219
Taxus caespitosa var. **angustifolia** Spjut, var. nov.—**1(1):**268
Taxus caespitosa var. **latifolia** (Pilger) Spjut, comb. nov.—**1(1):**269
Taxus canadensis var. **adpressa** (Hort. ex Carrière) Spjut, comb. nov.—**1(1):**274
Taxus canadensis var. **minor** (Michx.) Spjut, comb. nov.—**1(1):**274
Taxus contorta var. **mucronata** Spjut, var. nov.—**1(1):**260
Taxus florinii Spjut, sp. nov.—**1(1):**222
Taxus globosa var. **floridana** (Nutt. ex Chapm.) Spjut, comb. nov.—**1(1):**224
Taxus kingstonii Spjut, sp. nov.—**1(1):**240
Taxus mairei var. **speciosa** (Florin) Spjut, comb. et stat. nov.—**1(1):**246
Taxus obscura Spjut, sp. nov.—**1(1):**235
Taxus phytonii Spjut, sp. nov.—**1(1):**237
Taxus suffnessii Spjut, sp. nov.—**1(1):**226
Taxus umbraculifera var. **hicksii** (Hort. ex Rehder) Spjut, comb. nov.—**1(1):**279
Taxus umbraculifera var. **microcarpa** (Trautv.) Spjut, comb. nov.—**1(1):**279
Taxus umbraculifera var. **nana** (Rehder) Spjut, comb. nov.—**1(1):**281
Tetrazygia paralongicollis Judd, Ionta, Clase & Skean, sp. nov.—**2(1):**35
Thamnocalamus chigar (Stapleton) Stapleton, comb. nov.—**1(1):**139
Thamnocalamus nepalensis (Stapleton) Stapleton, stat. nov.—**1(1):**139
Thamnocalamus occidentalis (Stapleton) Stapleton, stat. nov.—**1(1):**139
Thecagonum strigulosum (DC.) Terrell & H. Rob., comb. nov.—**1(1):**377
Tocoyena arenicola Delprete, sp. nov.—**2(2):**988
Trochanthera G.O. Poinar, K.L. Chambers & A.E. Brown, gen. nov.—**2(2):**1168
Trochanthera lepidota G.O. Poinar, K.L. Chambers & A.E. Brown, sp. nov.—**2(2):**1168
Vaccinium beamanianum Wilbur & Luteyn, nom. nov.—**2(1):**219
Vaccinium campanense Wilbur & Luteyn, sp. nov.—**2(1):**234
Vaccinium chihuahuense Wilbur & Luteyn, sp. nov.—**2(1):**220
Vaccinium uliginosum subsp. **vulcanorum** (Kom.) Alsos & Elven, comb. et stat. nov.—**2(1):**442
Vahlodea latifolia subsp. **paramushirensis** (Kudô) Elven, comb. nov.—**2(1):**435
Varronia bullata subsp. **humilis** (Jacq.) Feuillet, comb. nov.—**2(2):**837
Varronia cremersii (Feuillet) Feuillet, comb. nov.—**2(2):**838
Varronia marioniae (Feuillet) Feuillet, comb. nov.—**2(2):**839
Xyris panacea L.C. Anderson & Kral, sp. nov.—**2(1):**1

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